cod, regardless of the groundfish fishery in which they are caught. Many of the new measures implemented in this period directly result from requirements of the Sustainable Fisheries Act (SFA). Additionally, the American Fisheries Act (AFA) conferred many social and economic benefits on the pollock fisheries.

Economic and social benefits have been conferred on the industry also by the allocations of Pacific cod, continuation of the sablefish and halibut IFQ Program, continuation and expansion of the CDQ Program, and implementation of the LLP in 2000.

2.7.3 Stock Assessments for Alaska Groundfish Stocks

The Alaska Fisheries Science Center (AFSC) is responsible for GOA and BSAI groundfish assessments. This responsibility developed in the 1970s in response to the perceived need by U.S. fishery scientists to gain some management control or influence over the expanding foreign fisheries on Alaska's bottomfish. Initial efforts were directed at monitoring the foreign catch levels through bilateral agreements for the exchange of catch statistics and international cooperative program to conduct independent fishery resource surveys. The Magnuson-Stevens Act gave NMFS authority to regulate foreign and domestic fisheries within the U.S. EEZ. The Act marks the beginning of NMFS data collection of fisheries information to generate stock assessments of major groundfish resources. Stock assessments are updated annually. Reports are prepared and reviewed by scientists from AFSC, the Alaska Department of Fish and Game (ADF&G), and the University of Alaska Fairbanks, with support of the Council's BSAI and GOA groundfish plan teams.

Stock assessment analysis is a way to estimate how many fish there are in a specific geographic ocean area or fishing grounds and to predict how these fish stocks or populations will respond to harvesting. Scientists use resource survey and fishery information in mathematical calculations to estimate how many fish are in a specific management area of the ocean (abundance or biomass). Life history information (growth and maturity) is used to estimate how many fish can be caught in a fishing season without impacting future stocks and while accounting for natural mortality, including removals by predators. Fishery managers use the biomass and fishing rates information to determine the allowable amount of fish that can be caught during an upcoming fishing season. Managers weigh economic and social considerations, along with biological and ecological concerns. Scientists, on the other hand, are primarily concerned with biological limits and stock production variability. The assessments are reviewed by the Council's groundfish plan teams, which are composed of biologists, economists, and mathematicians from government agencies and academia. The plan teams compile the individual species assessments into an annual SAFE document, which contains information on historical catch trends, biomass estimates, preliminary ABC estimates, harvest impact assessments, and alternative harvesting strategies. The plan team's recommendations are passed on to the Council and its advisory committees.

2.7.3.1 Stock Assessment Modeling

Three analytical assessment methods are typically used for Alaska groundfish: index methods, stock synthesis, and Automatic Differentiation (AD) model builder. The simplest assessment is an index of population size or biomass based primarily on resource surveys. A number of survey methods have been developed to estimate abundance or biomass of a fish stock. The survey method selected is usually designed to specifically target one or more stocks in a specific area. The exact survey method may differ among fishing grounds and target stocks. However, scientists are careful to maintain standard sampling methods to ensure consistency and comparability of the data over time by following consistent protocols and deploying standardized sampling gear to catch fish at a specific station location. Fish abundance or biomass estimtes are derived by multiplying the average catch rate by the size of the survey area. The results can be either expressed as an index of abundance or estimate of stock biomass in metric tons. Stock assessments may be based on the most recent survey or on an average of survey estimates over time. The latter approach is somewhat limited because it does not typically precisely forecast trends in abundance, particularly when surveys occur infrequently. Furthermore, survey biomass estimates can be biased or inaccurate if the sampling gear is not efficient in capturing all the fish at sampling stations, if fish for some reason avoid a particular habitat being sampled or if a significant portion of the stock is outside the survey area. Thus in many cases, a survey biomass estimate may be a conservative estimate. The more frequent the surveys, the longer the time series of index of abundance or biomass, and thus the better scientists are at judging a survey's ability to track true trends in stock magnitude.

Assessment methods can be greatly improved if annual catch data and age composition from fisheries and resource surveys are available. For the Alaska groundfish fisheries, catch quantities are monitored by a program that includes at-sea observers and sampling for shoreside landings. Roughly 30,000 observer days (equivalent to 114 full-time employees) are expended annually to collect catch data from the Alaska groundfish fisheries. All vessels capable of hosting an observer may be required to do so at the vessel's expense. As currently implemented, vessels over 125 ft in length are required to have observers onboard 30 percent of the time; vessels under 60 ft are generally exempt from observer requirements. Most fishing vessels operating in the BSAI exceed the 125-ft limit, while most of the fishing vessels in the GOA are smaller than 125 ft. The recreational harvest of groundfish in Alaskan waters is a minor component of the total catch.

Observers collect biological data, such as otoliths (ear bones, which grow in layers like tree rings), length frequencies, stomach samples, and maturity stage for a variety of species. Estimates of age composition come from otolith samples collected by observers and scientists conducting resource surveys. The age data are combined with the (typically) large sample of fish lengths measured from the fleet catches and resource surveys. The appearance of small, younger fish provide data to forecast the strength of incoming year (all fishes born in a particular year). The survival and growth of the eggs, larvae, and juvenile fish are highly variable, due to natural conditions and the variability of the marine environment. Recruitment is the principal component of the variability of of a fish stock's annual production. As a result, interannual variability in recruitment is a major source of uncertainty is projecting stock trends. Therefore, the ability to determine the age-structure of a fish population for the time series of the fishery is critical to accurately assessing a stock, particularly if it has undergone major swings in abundance.

With a time series of age composition data, scientists can employ complex population models, such as Stock Synthesis and AD model builder software, to apply biological characteristics and the dynamics of fish populations to estimate population trends over time, sustainable harvest rates, and biomass levels. For most Alaska groundfish, spawning is highly seasonal, so that all fish in a particular year class will have been born within a month or two of each other. Stock Synthesis and AD model builder are age-structured models, meaning that they keep track of each year class as it ages, enters the fishery, and eventually dies out. Recruitment occurs when a year class begins to be captured by fishing gear. For example, the relatively strong 1994 year class of pollock in the GOA "recruited" to the fishery in 1996 at age two; in 1999, at age five, it was 36 percent of the total pollock catch. Being able to keep track of year classes improves abundance estimates and allows scientists to better predict short-term trends.

The Stock Synthesis computer model is used for many Alaska groundfish assessments. This program was developed by NMFS scientist Dr. Richard Methot, formerly at AFSC, as a tool for incorporating complex fishery and survey data in a single framework (Methot 1990). Stock synthesis requires fewer assumptions about data than earlier age-structured methods, such as cohort analysis. Quantities in the model that are uncertain are estimated using appropriate statistical methods. The key philosophy is to treat observations, such as estimates of catch at age in a given year or survey biomass estimates, as random quantities about some true underlying values.

One way to think about how the program is designed is to imagine trying to say something about a stock of fish before looking at any data. Given that the species of fish is known, along with some general biological characteristics, it is possible to synthesize the abundance of that stock given some crude approximations. The essence of the initial dataless or synthesized population model can be illustrated in the following example. First, assume that the fishery had average catches of about 500 mt of catch for the past 10 years (prior removals were insignificant), then assume that in year 10 the harvest represented about 10 percent of the total stock. Given some assumptions about the natural mortality rate and the average weight at age, the abundance trend can be sketched out. The calculation used to construct population numbers is complete, but observed catch and survey data and values for various biological parameters must be incorporated to add realism to this synthesized stock. First the biological guesses (such as average weights at age) are replaced with estimates based on real data. Similarly, information on longevity and reproductive output of the species is incorporated to estimate the natural mortality rate. Information about gear type and surveys provide background on the selectivity patterns to be expected. Running the model at this point improves the realism and scales the population values in general terms. Further refinements occur as age or size composition data are added, which provide critical information on the variability of year-class strengths and historical pattern of age structure of the population. The computer model can then be tuned–a process called optimization–by adjusting the several hundred parameter values using a maximizing algorithm until the simulation results become most consistent with the observations.

AD model builder is a new modeling environment for developing and fitting complex statistical models (Fournier 1998). It is more flexible than Stock Synthesis because almost any kind of population model can be written in computer code and fit using available data. Most applications of AD model builder to Alaska groundfish are age-structured models, which are similar but have several advantages over Stock Synthesis. First, the optimization routine in AD model builder takes advantage of recent methodological advances in computer science. AD model builder also provides a suite of statistical tools for evaluating uncertainty. Finally, because the modeling environment is open-ended, the analyst can tailor the assessment model to the unique characteristics of the stock and the available information. It is anticipated that more age-structured assessments in the future will use AD model builder to assess Alaska groundfish stocks.

Sablefish

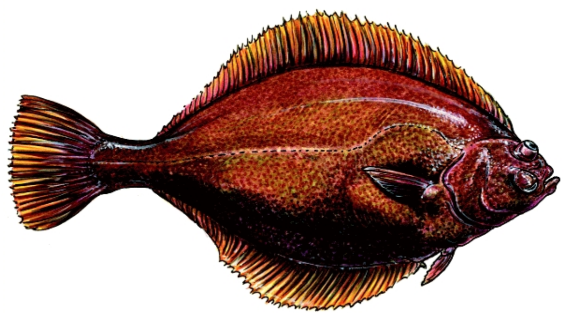
One of NMFS's primary long-term objectives is to reduce uncertainty in stock assessments. Moving from an assessment based on a biomass index, or an aggregate biomass model, to an age-structured assessment is a positive step towards achieving this objective. In 1990, four Alaska groundfish assessments were based on age-structured models. In 1999, 18 assessments were based on age-structured models, and 19 were based on a survey index (Table 2.7-9). Further refinements, such as the development of AD model builder applications for Alaska groundfish, may further reduce uncertainty, but only moderate gains can be expected. The real strength of these modern assessment methods lies in their ability to realistically model the uncertainty inherent in the assessment processes. Paradoxically, this may make uncertainty appear to increase. For example, earlier assessment typically provided only a point estimate of current stock size.

Using AD model builder, it is possible to obtain confidence limits for current stock size that reflect the uncertainty in the input parameters and how well the model fits the data. These confidence limits may be rather large for many groundfish stocks.

Table 2.7-9 Methods Used to Update Annual Stock Assessments for Alaska Groundfish, 1999

Species	Area	Assessment Method
Walleye pollock	BS	AD Model Builder
	Aleutian Islands	Survey Index
	Bogoslof	Survey Index
	GOA	AD Model Builder
	Southeast	Survey Index
Pacific cod	BSAI	Stock Synthesis
	GOA	Stock Synthesis
Sablefish	GOA and BSAI	AD Model Builder
Atka mackerel	Aleutian Islands	Stock Synthesis
Yellowfin sole	BSAI	AD Model Builder
Rock sole	BSAI	AD Model Builder
Greenland turbot	BSAI	Stock Synthesis
Arrowtooth flounder	BSAI	Stock Synthesis
	GOA	AD Model Builder
Flathead sole	BSAI	Stock Synthesis
	GOA	AD Model Builder
Alaska plaice	BSAI	AD Model Builders
Other flatfish	BSAI	Stock Index
Pacific ocean perch	BS	Stock Synthesis
	Aleutian Islands	Stock Synthesis
	GOA	Stock Synthesis
Other red rockfish	BS	Survey Index
Sharpchin/northern	Aleutian Islands	Survey Index
Northern rockfish	GOA	Survey Index
Shortraker/rougheye	Aleutian Islands	Survey Index
	GOA	Survey Index
Other rockfish	BS	Survey Index
	Aleutian Islands	Survey Index
	GOA	Survey Index
Squid	BSAI	Survey Index
Other species	BSAI	Survey Index
Deep water flatfish	GOA	Survey Index
Rex sole	GOA	Survey Index
Shallow water flatfish	GOA	Survey Index
Pelagic shelf rockfish	GOA	Survey Index
Thornyhead rockfish	GOA	AD Model Builder
Demersal shelf rockfish	GOA	Survey Index
Total by assessment method		
Stock Synthesis	9	
AD Model Builder	9	
Survey Index	19	

Notes: BSAI – Bering Sea and Aleutian Islands
GOA – Gulf of Alaska



Yellowfin sole

For the BSAI, scientists contribute to annual groundfish assessment reports for 16 stocks and six multispecies groups, including walleye pollock (3 areas), Pacific cod, Atka mackerel, yellowfin sole, Greenland turbot, arrowtooth flounder, rock sole, flathead sole, Alaska plaice, other flatfish, Pacific ocean perch (2 areas), sharpchin/northern rockfish, shortraker/rougheye rockfish, other red rockfish, other rockfish (2 areas), sablefish, squid, and other species. For the GOA, 15 assessments are updated annually, including walleye pollock (2 areas), Pacific cod, thornyhead rockfish, Pacific ocean perch, shortraker/rougheye rockfish, northern rockfish, demersal shelf rockfish, pelagic shelf rockfish, other rockfish, arrowtooth flounder, rex sole, shallow water flatfish, sablefish, and other species. The stocks or stock groups assessed for each plan are the most valuable species in the groundfish complex, accounting for a high percentage of the catch. Periodically, new species or species groups are added to the list. Often, models are modified substantially to accommodate new information and modeling improvements. The addition of another year of data also improves certainty of the model estimates of stock abundance and recruitment for prior years.

2.7.3.2 Independent Resource Surveys

Measuring fish stock abundance or biomass in the ocean is not easy. Unlike trees, fish cannot simply be counted because they are out of sight, below the water surface. Counting is further complicated because fish move around and may migrate extensively over relatively short time periods. For oceanic fish stocks, the survey sampling method is the only feasible option for estimating fish abundance independent of the fishery. The science of fishery resource surveys for the northeast Pacific Ocean, developed over the past 40 years, has been documented by Dr. Don Gunderson from the University of Washington in Surveys of Fisheries Resources (Gunderson 1993).

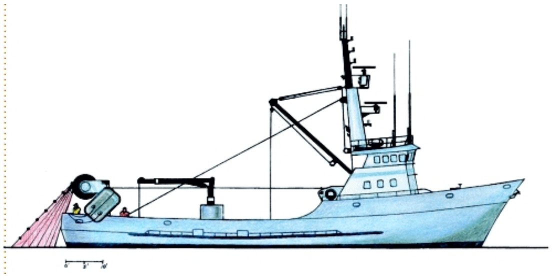
Several different surveys have been developed for the BSAI and GOA areas, including bottom trawl surveys, acoustic echo-integration/trawl surveys, and longline surveys. Each survey has its own unique strengths and weaknesses for estimating abundance depending on the fish's social behavior, preferred habitat, location in the water column or proximity to the sea floor, swimming ability, and attraction to bait, among other variables. For example, the bottom trawl survey can do a good job of estimating rock sole biomass, but will do a poorer job with midwater or pelagic fishes such as herring and squid. Fish without air bladders or fish that live on the sea floor, are very difficult to detect by acoustic survey systems. The AFSC's primary methods for estimating abundance and distribution of Alaska's groundfish resources include area-swept bottom trawl surveys for shellfish and bottomfish stocks, echo-integration/trawl surveys (acoustic surveys) for the dominant semipelagic stocks, such as pollock, and longline surveys for measuring relative abundance of valuable bottom species than inhabit the deeper waters of the upper portion of the continental slope.

The NMFS survey strategy for Alaska groundfish resources was initially formulated in the mid-1970s but it was not fully implemented until 1984. The comprehensive survey strategy consists of a suite of annual and triennial bottom trawl and acoustic surveys alternating among the eastern Bering Sea, Aleutian Islands, GOA, and the West Coast regions. Annual surveys have been conducted for the crab and groundfish stocks in the Bering Sea, spawning pollock in Shelikof Strait of the GOA, and Bogoslof Island area of the Bering Sea, and sablefish in the GOA. In recent years, an area of approximately 600,000 square km have been sampled annually with as many as 1,400 stations on the NMFS bottom trawl surveys. The winter and summer acoustic surveys cover about 15,000 km of tracklines annually. The annual Alaska sablefish longline survey covers about 95,000 square km and fishes 16 km (7,200 hooks) of longline per station over a depth range of about 660 to 3,960 ft at about 90 stations.

The history of NMFS groundfish research off Alaska began with the Bureau of Commercial fisheries exploratory fishing research groups in the late 1950s. They are accredited with the development of the area-swept method of estimating bottomfish abundance in the northeast Pacific Ocean. Most of the AFSC's standardization for trawl designs, gear deployment, on-deck catch sampling procedures, and data analysis were initiated by this group. The trawl survey of the eastern Bering Sea shelf area began in the late 1960s by NMFS scientists from the Auke Bay Laboratory for estimating the abundance of red king crab, but it was not until 1975 that the current standard grid survey was implemented to measure the abundance of crab and groundfish. The survey has been conducted annually since 1979.

The original survey gear was a 400 Eastern otter trawl, a two-seam trawl designed to catch flatfish. This trawl is made with 4- and 3.5-in. nylon webbing. This net was enlarged in the early 1980s to more closely match the horsepower of survey vessels. Both trawls were fished with a footrope made of a single steel cable wrapped with rope and rubber hose and attached to chain tied to the front edge of the bottom of the net. This footrope design was chosen because it effectively fishes the organisms living on the seafloor, particularly on the relatively smooth bottom in the eastern Bering Sea. The trawl net was spread with standard (9 ft by 6 ft) V doors. The modified net has a 103.6 ft long footrope and fishes with an opening about 56 ft wide and 8 ft high.

The time series for the triennial bottom trawl surveys over the continental shelf began in 1977 for the West Coast off Washington, Oregon, and California; 1980 for the Aleutian Islands; and 1984 for the GOA. The standard trawl for these surveys was initially a four-seam, high-rise net made with 5-in. nylon webbing, referred to as the *nylon Nor'eastern trawl*. The net was upgraded including replacing the nylon webbing with 5-in. polyethylene webbing and replacing the net wings with a cut away wing design. This modification is referred to as the *poly Nor'eastern trawl*. The two nets were compared over two years (1986 and 1987) following a rigorous experimental design. No significant differences in catch rates were found. The modified net fishes with an average width opening of about 52.8 ft and a height of about 24.75 ft. The footrope design of both nets is roller gear design made with 14-in. bobbins. The net is spread by standard V doors. The codends of all the NMFS survey trawls are fitted with a 1.25-in. mesh liner to retain small or juvenile fish. All survey nets are built and refurbished to strict standards by a team of AFSC's gear specialists. Also, for a particular survey, identical fishing gear (whether trawl, longline, or sonar) is used at each station, year after year. Survey gear is generally designed to catch fish over a wide range of sizes. Hence, surveys provide a consistent sample of fish from year to year, and provide information on prerecruit-sized fish that would otherwise not be available for stock assessment. Survey stations are either laid out in a systematic pattern over the fishing grounds or in a stratified random pattern. The area-swept estimate of biomass is derived from the average of the catch rates for all survey (stratum) stations, multiplied by the geographic area of the survey (stratum). The catch rate for a station is the ratio of catch for a species, divided by the area fished by the trawl during the tow. The area fished is determined by the width of the net spread multiplied by length of the tow when the net is in contact with the seafloor.


Bottom trawler

The Bering Sea bottom trawl survey is conducted annually during the months starting as early as late May to August. The survey is based on a grid of fixed, equally spaced, survey stations that allow for sampling across all habitat types. Each station is located approximately 20 nm apart, giving a sampling intensity of one station for every km 383 square nm (Figure 2.7-14). The survey has been conducted

Figure 2.7-14 Station pattern for annual Bering Sea crab-groundfish bottom trawl survey.

by two vessels over a 65-day period. Since 1993, the same two commercial fishing trawlers, which happen to be identical sister ships, have been chartered to carry out the survey. The survey samples approximately 400 trawl stations over 460,000 square km inside the 660-ft depth contour (Table 2.7-10). The catch from each tow is first sorted by species, then weighed and counted to come up with total values. Each species component is sampled for sex composition, individual lengths and weights, and, as needed, biological samples such as fish scales and otoliths for age and growth information, and gonads for maturity stage. This information is used to evaluate reproductive activity at different sizes and ages. Stomach samples are also collected to provide food habits data (who's eating who, and how much). Total biomass is estimated using an area-swept method. The density of fish from all survey stations is averaged and extrapolated to the surveyed area of the Bering Sea to provide stock biomass estimates. Although over 80 species of fish are usually identified in the survey catches, biomass estimates are reported for only 18 species or species groups, which include the commercially important stocks of walleye pollock, Pacific cod, yellowfin sole, rock sole, flathead sole/Bering flounder, Alaska plaice, Greenland turbot, arrowtooth flounder, Kamchatka flounder, and Pacific halibut.

The bottom trawl survey along the Aleutian Islands from 165°W to 170°30' E has been conducted triennially from June to early August from 1980 to 1986 and 1991 to present time by two fishing vessels. On the first three surveys, the Japanese fisheries agency provided one vessel and the other was either a NOAA ship or fishing vessel chartered by NMFS. The U.S. vessels used the standard Nor'eastern survey trawl; the Japanese vessel supplied its own trawl gear. The survey followed a stratified, random station pattern, with just under 500 stations, covering the continental shelf and slope from 16 m inshore depth out to a depth of 1,650 ft for a total area of 66,900 square km (Table 2.7-10 and Figure 2.7-15). Since 1991, the survey has been conducted from two chartered U.S. fishing vessels for about 120–130 vessel days at sea. Starting with 1997 survey, the standard 30-minute tow was reduced to 15 minutes to increase the number of possible stations and reduce the quantity of fish caught per tow closer to 1 metric ton on average. Over 100 species of fish and vertebrates were The area for the GOA triennial survey is just under 320,000 square km, including the upper slope. The offshore extent of the survey has varied by survey year, depending on survey objectives and fishing depth limits of the chartered vessels (Figure 2.7-16). Starting with the 1996 survey, the standard trawl tow was reduce from 30 minutes to 15 minutes. About 140 species of fish and 200 species of invertebrates were identified in the survey catches. Survey results are summarized for 30 fish species, including arrowtooth flounder, Pacific ocean perch, walleye pollock, Pacific cod, Pacific halibut (the five most abundant), flathead sole, southern rock sole, northern rock sole, rex sole, Dover sole, yellowfin sole, Alaska plaice, starry flounder, English sole, butter sole, Atka mackerel, sablefish, northern rockfish, rougheye rockfish, light dusky rockfish, dark dusky rockfish, sharpchin rockfish, shortraker rockfish, shortspine thornyhead, redstripe rockfish, silvergray rockfish, harlequin rockfish, redbanded rockfish, yellowmouth rockfish, and rosethorn rockfish.

Beginning with the 1999 GOA survey, AFSC initiated a new survey strategy to increase the frequency of the survey schedule from triennial to biennial (Table 2.7-11). This new schedule continues the annual eastern Bering Sea bottom trawl survey for crab and groundfish. The summer bottom trawl survey is expanded to include a biennial shelf survey alternating between the GOA and the Aleutian Islands, a biennial slope survey alternating between the GOA and the eastern Bering Sea, and a biennial acoustic summer survey targeting on walleye pollock alternating between the eastern Bering Sea and the GOA. Full implementation of this new schedule depends in part on transferring AFSC survey responsibility for the west coast groundfish resources to the Northwest Fisheries Science Center. Currently, the centers are preparing for the transition of responsibilities to be completed by the end of the 2001 triennial cycle. Additional research is under way to further quantify the various sources of bias in the standard bottom trawl tows resulting from fish being herded by the trawl doors into the path of the capture net, the avoidance of fish to escape capture in front of the oncoming trawl, or the escape of fish through the trawl meshes. Although this is a new line of research, considerable progress is being made each year.

Table 2.7-10 Survey Coefficient of Variation and Survey Frequency by Species and Species Groups

Species/Species Group	Species Type	Area	Survey CV	Survey Type	Triennial Cycle in GOA and Aleutian Islands			Biennial Cycle in GOA and Aleutian Islands		
					Number of Surveys in 10 Years	10–Year CV	Ranking	Number of Surveys in 10–Years	10–Year CV	Ranking
Rock sole	Flatfish	EBS	8%	BT	10.0	0.025	1	10.0	0.025	1
Pacific cod	Roundfish	EBS	9%	BT	10.0	0.028	1	10.0	0.028	1
Sablefish	Roundfish	GOA	10%	LL	10.0	0.032	1	10.0	0.032	1
Yellowfin sole	Flatfish	EBS	10%	BT	10.0	0.032	1	10.0	0.032	1
Arrowtooth flounder	Flatfish	GOA	9%	BT	3.3	0.047	2	6.7	0.033	1
Deep water flatfish	Flatfish	GOA	9%	BT	3.3	0.048	2	6.7	0.034	1
Flathead sole	Flatfish	EBS	11%	BT	10.0	0.036	1	10.0	0.036	1
Alaska plaice	Flatfish	EBS	12%	BT	10.0	0.036	1	10.0	0.036	1
Rex sole	Flatfish	GOA	9%	BT	3.3	0.051	2	6.7	0.036	1
Arrowtooth flounder	Flatfish	EBS	12%	BT	10.0	0.037	1	10.0	0.037	1
Flathead sole	Flatfish	GOA	12%	BT	3.3	0.063	3	6.7	0.045	2
Walleye pollock	Roundfish	GOA	19%	BT/EIT	13.3	0.052	2	16.7	0.046	2
Other rockfish	Rockfish	EBS	15%	BT	10.0	0.048	2	10.0	0.048	2
Shortspine thornyhead	Rockfish	GOA	13%	BT	3.3	0.069	3	6.7	0.049	2
Skates	Other species	GOA	13%	BT	3.3	0.072	3	6.7	0.051	2
Smelts	Other species	GOA	14%	BT	3.3	0.079	3	6.7	0.056	2
Shortraker/rougheye	Rockfish	GOA	15%	BT	3.3	0.080	3	6.7	0.056	2
Shallow water flatfish	Flatfish	GOA	15%	BT	3.3	0.081	3	6.7	0.057	2
Sculpins	Other species	GOA	15%	BT	3.3	0.084	3	6.7	0.059	2
Pacific cod	Roundfish	GOA	15%	BT	3.3	0.084	3	6.7	0.059	2
Walleye pollock	Roundfish	EBS	23%	BT/EIT	13.3	0.063	3	13.3	0.063	3
Squid	Other species	GOA	17%	BT	3.3	0.092	4	6.7	0.065	3
Other rockfish	Rockfish	Aleutian Islands	18%	BT	3.3	0.101	4	6.7	0.071	3
Walleye pollock	Roundfish	Aleutian Islands	19%	BT	3.3	0.104	4	6.7	0.073	3
Pacific ocean perch	Rockfish	Aleutian Islands	21%	BT	3.3	0.115	5	6.7	0.082	3
Other flatfish	Flatfish	EBS	26%	BT	10.0	0.082	3	10.0	0.082	3
Other slope rockfish	Rockfish	GOA	21%	BT	3.3	0.116	5	6.7	0.082	3
Greenland turbot	Flatfish	EBS	31%	BT	10.0	0.099	4	10.0	0.099	4

Table 2.7-10 (Cont.) Survey Coefficient of Variation and Survey Frequency by Species and Species Groups

Species/Species Group	Species Type	Area	Survey CV	Survey Type	Triennial Cycle in GOA and Aleutian Islands			Biennial Cycle in GOA and Aleutian Islands		
					Number of Surveys in 10 Years	10–Year CV	Ranking	Number of Surveys in 10–Years	10–Year CV	Ranking
Sharks	Other species	GOA	26%	BT	3.3	0.145	6	6.7	0.103	4
Other red rockfish	Rockfish	EBS	33%	BT	10.0	0.104	4	10.0	0.104	4
Sharpchin/northern	Rockfish	AI	28%	BT	3.3	0.156	6	6.7	0.110	4
Pacific ocean perch	Rockfish	EBS	35%	BT	10.0	0.111	4	10.0	0.111	4
Pacific ocean perch	Rockfish	GOA	30%	BT	3.3	0.165	7	6.7	0.117	5
Shortraker/rougheye	Rockfish	AI	32%	BT	3.3	0.178	7	6.7	0.126	5
Southeast pollock	Roundfish	GOA	33%	BT	3.3	0.178	7	6.7	0.126	5
Atka mackerel	Roundfish	AI	38%	BT	3.3	0.211	8	6.7	0.149	6
Pelagic rockfish	Rockfish	GOA	39%	BT	3.3	0.215	9	6.7	0.152	6
Northern rockfish	Rockfish	GOA	41%	BT	3.3	0.224	9	6.7	0.159	6
Octopus	Other species	GOA	48%	BT	3.3	0.265	11	6.7	0.187	8
			Survey CV				**Ranking**			**Ranking**
Flatfish mean			14%				2.1			1.9
Roundfish mean			21%				3.8			2.9
Rockfish mean			26%				5.2			3.9
Other species mean			22%				4.9			3.5

Notes: Ranks are determined by the 10-year CV (= CV/sqrt [no. surveys in 10 yrs]), divided by the minimum 10 year-CV for all species (rock sole in the eastern Bering Sea). They provide only a rough ordering of the expected precision of survey information concerning overall abundance and trend for each stock.
BT – bottom trawl
CV – coefficient of variation
EBS – eastern Bering Sea
EIT – echo-integration and trawl survey
GOA – Gulf of Alaska
LL – longline

Figure 2.7-15 Aleutian Island bottom trawl survey station locations. Source: NMFS

Figure 2.7-16 Gulf of Alaska bottom trawl survey station locations. Source: NMFS

Table 2.7-11 Stock Assessment Survey Strategy for the Gulf of Alaska and Bering Sea and Aleutian Islands Groundfish Resources Based on the 1999–2000 Biennial Cycle

Survey	Season	Frequency	No. of Vessels	Area (km^2)	No. of Stations or Trackline (km)	Days at Sea
Bottom Trawl Surveys						
Bering Sea shelf	Summer	Annual	2	463,000	400	135
Bering Sea slope	Summer	Biennial	1	25,000	100	35
Aleutian Islands shelf	Summer	Biennial	2	66,900	476	140
Gulf of Alaska shelf and slope	Summer	Biennial	3	320,000	870	220
Longline Surveys						
Gulf of Alaska slope	Summer	Annual	1	55,500	74	83
Bering Sea slope	Summer	Biennial	1	17,400	16	18
Aleutian Islands slope	Summer	Biennial	1	24,600	14	18
Acoustic Surveys						
Bering Sea pollock	Summer	Annual	1	340,000	10,200	60
Bogoslof pollock	Winter	Annual	1	31,000	2,300	11
Shelikof pollock	Winter	Annual	1	38,000	1,700	15

Notes: km – kilometers

In the mid-1960s, a program was initiated at the University of Washington with the support of Washington Sea Grant to develop acoustic technology and survey methods to measure fish abundance. A prototype echosounder and echo-integration system was first used by NMFS in the mid-1970s to measure the off-bottom (pelagic) component of the west coast Pacific whiting population. Based on the success of this research, standard surveys were designed to assess whiting in 1977 and Bering Sea pollock in 1979 as part of the summer triennial survey (see Figure 2.7-17 for a survey pattern example). In 1981, a winter acoustic survey was initiated to measure the spawning pollock abundance aggregated in Shelikof Strait. The winter survey was expanded in 1988 to assess spawning pollock concentrated in the Bogoslof Island area. Both surveys have been continued on an annual schedule. In the late 1980s, AFSC invested in second-generation echo-sounder and echo-integration technology. This new system was installed on the NOAA ship *Miller Freeman*, which has served as the principal vessel for AFSC acoustic surveys since then. This new equipment greatly improved the quality and accuracy of acoustic survey data and the capability to calibrate the system and to measure target strength (the acoustic reflectivity of an individual fish used to convert the magnitude of the acoustic echos from fish in the water column to fish density). The quality of the acoustic data was further enhanced by mounting the transducer on the *Miller Freeman*'s centerboard. This amidship location is forward of the noise field generated by propeller cavitation and away from any disturbances created by the air bubbles in the water flow over the ship's hull. This new system greatly enhanced the acoustic data and the capability of an acoustic survey to detect deeper and lower densities of fish. Although the *Miller Freeman* is the primary vessel used by the AFSC acoustic surveys, U.S. scientists frequently conduct surveys in cooperation with research vessels from foreign fisheries agencies. The current AFSC policy when undertaking cooperative acoustic surveys is to conduct a one- to three-day side-by-side survey to estimate intership calibration factors to provide a way to combine results from both vessels into one biomass estimate.

The successful application of acoustic survey technology to assess abundance of midwater, semipelagic marine fish resources requires that target species be the dominant species in the water column. This requirement

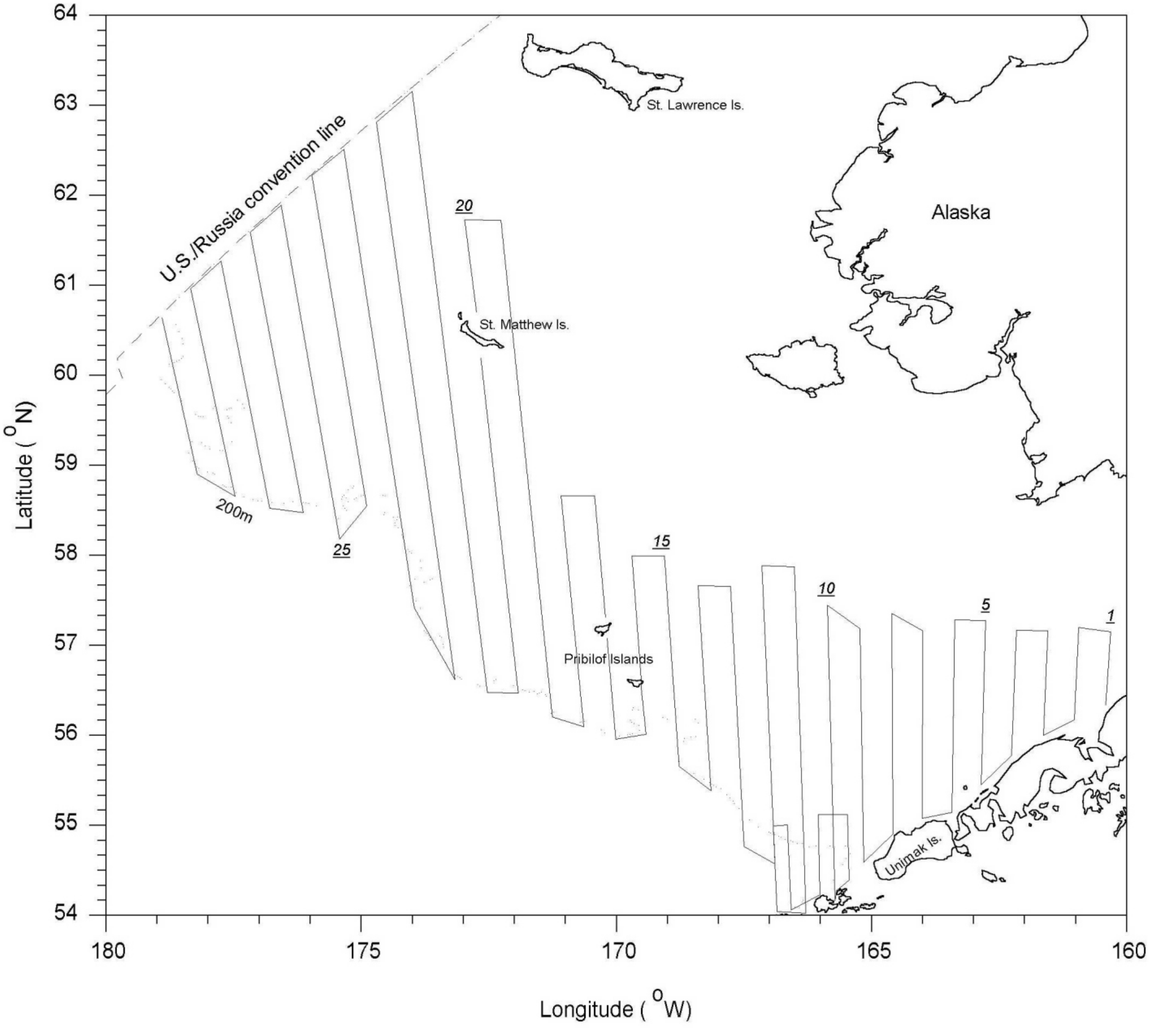


Figure 2.7-17 Example of a summer acoustic-midwater trawl survey pattern for pollock, eastern Bering Sea.

reduces the problem of signal contamination from other species. In addition, the acoustic system must be routinely calibrated during the course of the survey and in situ target strength measurements must be collected from single individual fish targets of known species, size, and depth. Current acoustic systems can not determine fish species or fish size, consequently a major component of an acoustic survey is sampling targets with bottom or midwater trawls. The trawl catches are critical for identifying species and collecting biological data (e.g., size, sex, age, maturity, and food habits).

Additional research efforts are needed to collect target strength data for all target species and to understand the effect of vessel and gear noise on the behavior of pollock sampled during acoustic surveys and bottomfishes from area-swept bottom trawl surveys. Statistical research continues to improve survey design so that the survey variance is minimized, considering fish schooling patterns, transect spacing, and continuous collection of acoustic data along the transects. Researchers are assessing the impact of vessel and gear noise on the AFSC acoustic survey for pollock using the *Miller Freeman*. Fish aggregations have been observed to change location and density as a vessel passes or a trawl net approaches. Fish avoidance could create a considerable bias in acoustic estimates of stock biomass, the composition (size and sex) of midwater trawl catches, and even in the catch rates from bottom trawl surveys. The biggest gains in the AFSC acoustic survey strategy will come from increasing the frequency of surveys in the eastern Bering Sea from triennial to biennial, alternating between the Bering Sea and the GOA. The new biennial schedule includes a new summer pollock survey to be conducted synoptically with the new biennial bottom trawl survey (Table 2.7-11). Currently, there is no summer acoustic survey in the GOA. The implementation of this summer survey in the GOA is hampered by the responsibility of the AFSC to also conduct acoustic surveys for Pacific whiting off the west coast.

A preliminary survey effort is needed to determine the feasibility of using acoustic surveys in the GOA during the summer because of the potentially high diversity of other fish and invertebrate species, which could contaminate pollock echos. The Bering Sea survey should be expanded into Russian waters because the Russian fishery has increased in the area immediately to the west of the U.S. EEZ. This survey expansion into Russian waters is critical, because pollock stocks are transboundary. Efforts in recent years to expand the survey have failed because the Russian government has refused to grant permission to the *Miller Freeman* to enter its waters.

In 1979 Japanese scientists from the National Research Institute of Far Seas Fisheries and AFSC scientists initiated a cooperative longline survey of the groundfish resources of the GOA upper continental slope. Sablefish inhabit the upper slope over a broad depth range extending out beyond 1,000 m. This survey developed into the principal method for measuring sablefish abundance in Alaska. After Japanese scientists withdrew from the cooperative survey, the AFSC initiated a second longline survey using U.S. fishing vessels and gear and a nearly identical survey design (Figure 2.7-18). A private Japanese fishing company agreed to continue the survey to ensure that the two surveys could be calibrated so that the times series for the two surveys could be linked. The two surveys were conducted together, with two vessels fishing the same stations just a few days apart. Design specifications were identical for the two surveys, including skate length, number of hooks per skate, distance between hooks, total number of skates fished per station, and type of bait. The primary difference was the style of hooks. Both surveys were conducted for seven years, 1988–1994, to establish comparative data sets. Subsequent analysis of the paired, observed catch rates showed a nearly identical relationship for the last five years. This consistency in catch rates provided the basis for adjusting the catch rates from the original survey to be comparable to the new U.S. survey, thereby forming one time series of abundance index of 21 years long. This survey is the primary data source for tracking trends in sablefish abundance, and it is used to allocate harvest quotas among fishery management areas. The early U.S. longline survey was restricted to the GOA management areas. In recent years, the survey was lengthened to include the Aleutian Islands area, and in alternate years, the eastern Bering Sea slope region (Table 2.7-10).

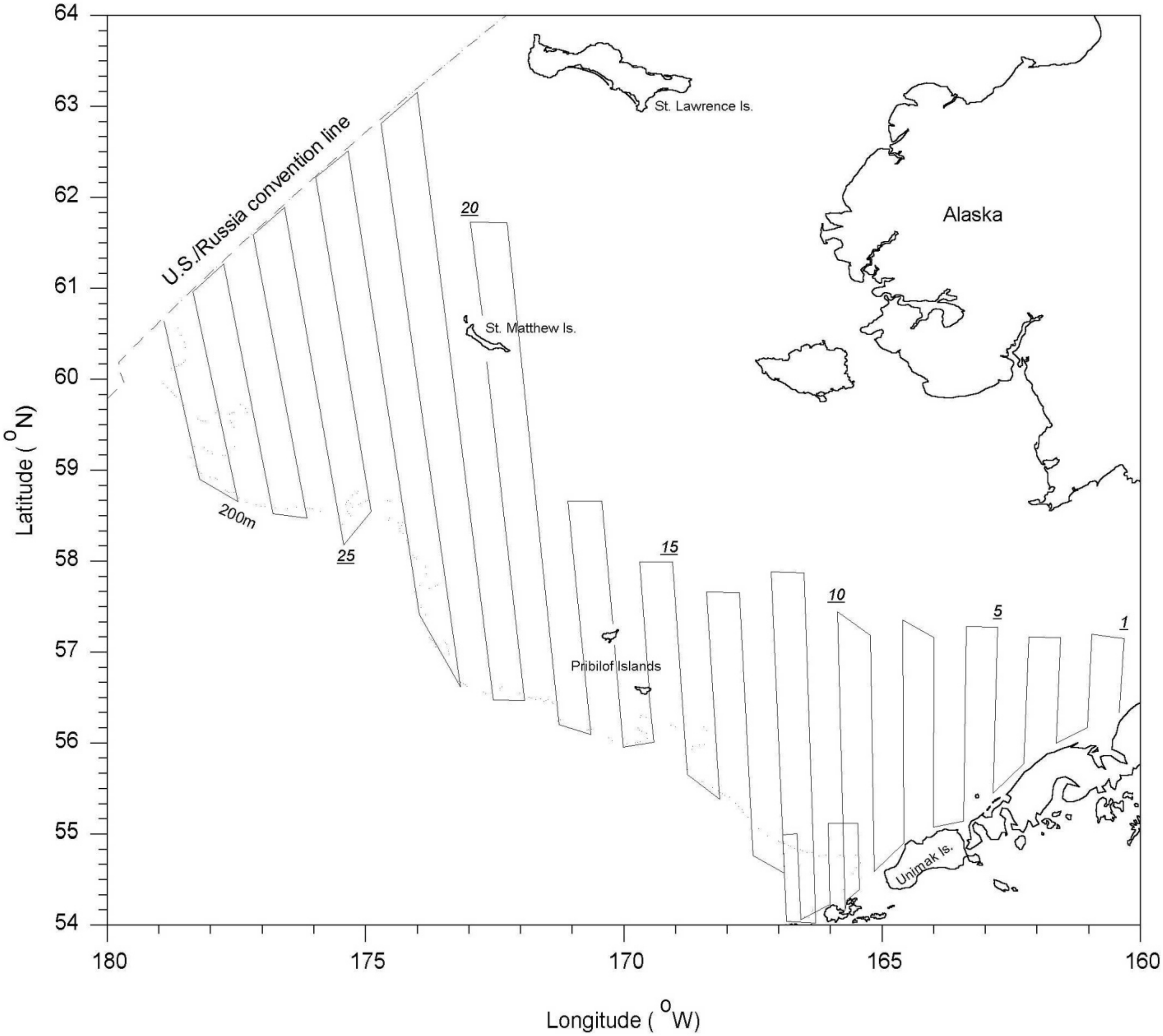


Figure 2.7-18 Example of a summer acoustic-midwater trawl survey pattern for pollock, eastern Bering Sea. Source: NMFS

Alaska groundfish stock assessment analyses have been ongoing for about 25 years. Increasingly more sophisticated over time, a number of these assessments are now based on complex age-structured models supported by high-speed desktop computers. These models depend on data collected by NMFS North Pacific Groundfish Observer Program and groundfish resource assessment surveys. The groundfish surveys conducted off Alaska are probably the most extensive survey effort implemented by a single government agency anywhere in the world. The survey strategy is currently being expanded to an annual/biennial cycle, which will greatly increase the pollock stock monitoring in the eastern Bering Sea and GOA and Aleutian Islands groundfish stocks. The increased age composition data from expanded surveys will also improve stock assessments and forecasts, particularly for the younger incoming year classes. Data collection management, observer and resource survey data has been enhanced by modern computer technology, which has expedited the availability of fishery catch data to allow in-season management of harvest quotas and of survey results to within 1 to 3 months. Both survey and catch data now become available in time to incorporate into annual stock assessment updates used to set ABCs for the upcoming fishing season. Furthermore, survey sample sizes are sufficient to provide coefficients of variation for the abundant stocks, which range from about 8 to 12 percent for many flatfish stocks and 20 to 40 percent for most rockfish species (Table 2.7-10). The biennial survey cycle will further increase the overall precision in biomass time series by 20 to 30 percent (Table 2.7-10). These surveys also provide the best database for identifying essential fish habitat, interspecific interactions, and biodiversity of marine ecosystems.

2.7.4 Derivation of Overfishing Level and Acceptable Biological Catch

Values for the Overfishing Level (OFL) and Acceptable Biological Catch (ABC) are developed according to definitions prescribed by Amendments 56/56 to the BSAI and GOA Groundfish FMPs (Appendix A and B). These definitions are governed by the Magnuson-Stevens Act and the National Standard Guidelines (Guidelines). The most recent revision of the Guidelines was published on May 1, 1998, reflecting changes resulting from passage of the Sustainable Fisheries Act (SFA) on October 11, 1996.

Two pieces of relevant statutory language are:

1. Section 3(29) of the Magnuson-Stevens Act defines <u>overfishing</u> as "a rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce the maximum sustainable yield on a continuing basis."
2. Section 303(a)(10) of the Magnuson-Stevens Act mandates that all FMPs "specify objective and measurable criteria for identifying when the fishery to which the plan applies is overfished (with an analysis of how the criteria were determined and the relationship of the criteria to the reproductive potential of stocks of fish in that fishery) and, in the case of a fishery which the Council or the Secretary has determined is approaching an overfished condition or is overfished, contain conservation and management measures to prevent overfishing or end overfishing and rebuild the fishery."

The Guidelines interpret the above mandate as requiring that each FMP specify, to the maximum extent possible, a pair of objective and measurable "status determination criteria" for each stock or stock complex covered by that FMP. One of these criteria is the maximum fishing mortality threshold, equivalent to OFL in the BSAI and GOA Groundfish FMPs. Exceeding the maximum fishing mortality threshold for a period of one year or more constitutes overfishing. The other status determination criterion is the minimum stock size threshold, which is covered in Section 2.7.5.

The Guidelines also draw a distinction between limit reference points, such as OFL, which management seeks to *avoid*, and *target* reference points, such as OY, which management seeks to *achieve* (ABC is another example of a target reference point). The Guidelines endorse a precautionary approach to setting target reference points, an approach characterized by three features:

1. Target reference points should be set safely below limit reference points.
2. A stock that is below its MSY level should be harvested at a lower rate than if the stock were above its MSY level.
3. Criteria used to set target catch levels should be explicitly risk averse, so that greater uncertainty regarding the status or productive capacity of a stock corresponds to greater caution in setting target catch levels.

The Guidelines' characterization of a precautionary approach was modeled upon the definitions of OFL and ABC found in the then-current BSAI and GOA Groundfish FMPs. The Council approved modifications to these definitions in June 1998 for the purpose of bringing them into compliance with changes mandated by passage of the SFA. The current definitions of OFL and ABC overfishing (NPFMC 1998) are shown below:

2.7.4.1 Acceptable Biological Catch

ABC is a preliminary description of the acceptable harvest (or range of harvests) for a given stock or stock complex. Its der ivation focuses on the status and dynamics of the stock, environmental conditions, other ecological factors, and prevailing technological characteristics of the fishery. The fishing mortality rate used to calculate ABC is capped as described under Section 2.7.4.2.

2.7.4.2 Overfishing

Overfishing is defined as any amount of fishing in excess of a prescribed maximum allowable rate. This maximum allowable rate is prescribed through a set of six tiers, which are listed below in descending order of preference, corresponding to descending order of information availability. The Council's Science and Statistical Committee (SSC) will have final authority for determining whether a given item of information is "reliable" for the purpose of this definition, and may use either objective or subjective criteria in making such determinations. For Tier 1, a "pdf" refers to a probability density function. For Tiers 1 and 2, if a reliable pdf of biomass (e.g., the biomass level that would describe a stock of fish at its maximum sustainable level) B_{MSY} is available, the preferred point estimate of B_{MSY} is the geometric mean of its pdf. For Tiers 1–5, if a reliable pdf of B is available (e.g., current biomass level), the preferred point estimate is the geometric mean of its pdf. For Tiers 1–3, the coefficient a is set at a default value of 0.05, with the understanding that the SSC may establish a different value for a specific stock or stock complex as merited by the best available scientific information. For Tiers 2–4, a designation of the form "$F_{X\%}$" refers to the F associated with an equilibrium level of spawning per recruit (SPR) equal to X percent of the equilibrium level of spawning per recruit in the absence of any fishing. If reliable information sufficient to characterize the entire maturity schedule of a species is not available, the SSC may choose to view SPR calculations based on a knife-edge maturity assumption as reliable. For Tier 3, the term $B_{40\%}$ refers to the long-term average biomass that would be expected under average recruitment and $F = F_{40\%}$.

1. *Information available: Reliable point estimates of B and B_{MSY} and reliable pdf of F_{MSY}.*
   - *1a. Stock status: $B/B_{MSY} > 1$*
     - $F_{OFL} = m_A$, the arithmetic mean of the pdf
     - $F_{ABC} \le m_H$, the harmonic mean of the pdf
   - *1b. Stock status: $a < B/B_{MSY} \le 1$*
     - $F_{OFL} = m_A \times (B/B_{MSY} - a)/(1 - a)$
     - $F_{ABC} \le m_H \times (B/B_{MSY} - a)/(1 - a)$
   - *1c. Stock status: $B/B_{MSY} \le a$*
     - $F_{OFL} = 0$
     - $F_{ABC} = 0$

2. *Information available: Reliable point estimates of B,* B_{MSY}, F_{MSY}, $F_{35\%}$, *and* $F_{40\%}$.

2a. *Stock status:* $B/B_{MSY} > 1$

$F_{OFL} = F_{MSY}$

$F_{ABC} \leq F_{MSY} \times (F_{40\%}/F_{35\%})$

2b. *Stock status:* $a < B/B_{MSY} \leq 1$

$F_{OFL} = F_{MSY} \times (B/B_{MSY} - a)/(1 - a)$

$F_{ABC} \leq F_{MSY} \times (F_{40\%}/F_{35\%}) \times (B/B_{MSY} - a)/(1 - a)$

2c. *Stock status:* $B/B_{MSY} \leq a$

$F_{OFL} = 0$

$F_{ABC} = 0$

3. *Information available: Reliable point estimates of B,* $B_{40\%}$, $F_{35\%}$, *and* $F_{40\%}$.

3a. *Stock status:* $B/B_{40\%} > 1$

$F_{OFL} = F_{35\%}$

$F_{ABC} \leq F_{40\%}$

3b. *Stock status:* $a < B/B_{40\%} \leq 1$

$F_{OFL} = F_{35\%} \times (B/B_{40\%} - a)/(1 - a)$

$F_{ABC} \leq F_{40\%} \times (B/B_{40\%} - a)/(1 - a)$

3c. *Stock status:* $B/B_{40\%} \leq a$

$F_{OFL} = 0$

$F_{ABC} = 0$

4. *Information available: Reliable point estimates of B,* $F_{35\%}$, *and* $F_{40\%}$.

$F_{OFL} = F_{35\%}$

$F_{ABC} \leq F_{40\%}$

5. *Information available: Reliable point estimates of B and natural mortality rate M.*

$F_{OFL} = M$

$F_{ABC} \leq 0.75 \times M$

6. *Information available: Reliable catch history from 1978 through 1995.*

OFL = the average catch from 1978 through 1995, unless an alternative value is established by the SSC on the basis of the best available scientific information

$ABC \leq 0.75 \times OFL$

In general, the above definitions represent an attempt to institute a precautionary approach consistent with the legal requirements of the Magnuson-Stevens Act and the practical constraints of existing data.

Precautionary Approach

Tiers 1–6 satisfy the first characteristic of a precautionary approach by placing a substantial buffer between OFLs and the annual ABC. Tiers 1–3 satisfy the second characteristic of a precautionary approach by decreasing fishing mortality rates for stocks that fall below the MSY level (or, in the case of Tier 3, for stocks that fall below a reference level somewhat higher than the MSY level). Tier 1 satisfies the third characteristic of a precautionary approach by reducing the target fishing mortality rate in direct relation to the level of uncertainty regarding the stock's productive capacity (i.e., greater uncertainty leads to a lower target fishing mortality rate).

Legal Requirements

All six tiers contain OFL definitions that are at least as conservative as the implied MSY control rule. In Tiers 1–3, the OFL definitions are equivalent to an MSY control rule based on constant fishing mortality when stocks are above reference levels, but they are substantially more conservative than an MSY control rule based on constant fishing mortality when stocks are below reference levels. In Tiers 4–5, the OFL definitions are equivalent to an MSY control rule based on constant fishing mortality. In Tier 6, the OFL definition is equivalent to an MSY control rule based on constant catch.

Practical Constraints

In Tier 1, the limit fishing mortality rate for a stock above its MSY level is the arithmetic mean μ_A of the statistical distribution of F_{MSY}, while the target fishing mortality rate is capped by the harmonic mean μ_H of the same distribution, following Thompson (1996). For example, if the estimate of F_{MSY} has a gamma distribution with a coefficient of variation of 50 percent, the target fishing mortality could be no higher than 75 percent of the limit fishing mortality rate. However, the methodologies presently used to conduct most stock assessments are not capable of deriving the statistics required by the Tier 1 definitions. Therefore, Tiers 2–6 of the current OFL and ABC definitions use surrogate or "proxy" fishing mortality rates developed to achieve approximately the same result as fishing according to the Tier 1 definitions. For example, Tier 2 views a reliable point estimate of F_{MSY} (i.e., a reliable point estimate irrespective of its distributional properties) as a proxy for μ_A. Tiers 3–4 view $F_{35\%}$ as a proxy for μ_A, following the Guidelines (Clark 1991), and "technical guidance" report (Restrepo et al. 1998). Tiers 3–4 also view $F_{40\%}$ as a proxy for μ_H, (Clark 1993, Mace 1994, and Restrepo et al. 1998). The natural mortality rate M is used as a proxy for μ_A in Tier 5, following the Guidelines and Restrepo et al. (1998), while a rate of 0.75M is used as a proxy for μ_H, following Restrepo et al. (1998). In Tier 6, where data are by definition insufficient to permit application of a reference fishing mortality rate to a projected stock size, average catch is used as a proxy for MSY while the target catch is capped at 75 percent of the proxy MSY (following Restrepo et al. 1998).

2.7.5 Specification of Total Allowable Catch

The FMPs divide the fish species likely to be taken in the groundfish fishery into four categories. The OY concept is applied to all except the "prohibited species" category.

A. Target Species–Those species that are commercially important and for which a sufficient database exists that allows each to be managed on its own biological merits. Accordingly, a specific TAC is established annually for each target species. Catch of each species must be recorded and reported. This category includes pollock, Pacific cod, yellowfin sole, Greenland turbot, arrowtooth flounder, rock sole, other flatfish, sablefish, Pacific ocean perch, other rockfish, Atka mackerel, and squid.

B. Other Species–Species groups that currently are of slight economic value and not generally targeted. This category contains species with economic potential or which are important ecosystem components, but sufficient data are lacking to manage each separately. Accordingly, a single TAC applies to this category as a whole. Catch of this category as a whole must be recorded and reported.

C. Nonspecified Species–Those species and species groups of no current economic value taken by the groundfish fishery only as an incidental catch in the target fisheries. Virtually no data exist that would allow population assessments. No record of catch is necessary. The TAC for this category is the amount that is taken incidentally while fishing for target and other species, whether retained or discarded.

D. Prohibited Species–Those species and species groups the catch of which must be returned to the sea with a minimum of injury, except when their retention is authorized by other applicable law. Groundfish species and species groups for which the quotas have been achieved are treated in the same manner as prohibited species.

The Council may set a maximum catch quota–the TAC–for target species and other species, either by individual species or groups of species. The groupings are based on commercial importance of a species or species group and whether sufficient biological information is available to manage a species or species group on its own biological merits. Catch specifications are made for each managed species or species group, and in some cases, by species and subarea. Because both GOA and BSAI FMPs have OY ranges for the aggregate groundfish target species, any of the target species assemblages can be assembled/disassembled during the annual TAC-setting process. Over the years, the Council has done such disassembling several times. For example, in the BSAI, arrowtooth flounder were combined with turbot, but broken out separately in 1986. Rock sole were combined with "other flatfish" but broken out separately in 1989. Red rockfish were combined with "rockfish" but broken out separately in 1991, and further broken out into sharpchin/northern and shortraker/rougheye rockfish in a subsequent year. Such disassembling can only occur with the target species category. The "other species" category, species that are not target species, requires an FMP amendment to break out a species and make it a target species category, as does the nonspecified species category. An FMP amendment would be required to make a nonspecified species a target species. Fish species' common and scientific names, and management group designation according to the FMPs and approved amendments (as of 1999) are summarized in Table 2.7-12.

The TAC specifications define upper harvest limits, or fishery removals, for the next fishing year. The 1999 interim and final TAC specifications, and actual harvest amounts, for the BSAI management area are contained in Table 2.7-13 and the GOA in Table 2.7-14. Similar tables for 2000 interim and final TAC specifications, minus the actual harvest amounts (those data are not available), are Tables 2.7-15 and 2.7-16. The sum of the TAC specifications is important because the fishery management plans specify the upper and lower ceilings for total TAC in each management area. In the BSAI, the lower limit is 1.4 million mt and the upper limit is 2 million mt (50 CFR 679.20(a)(1)(i)). In the GOA, the lower limit is 116,000 mt and the upper limit is 800,000 mt (50 CFR 679.20(a)(1)(ii)).

Suballocations of TAC are made for biological and socioeconomic reasons according to percentage formulas established through FMP amendments. For particular target fisheries, TAC specifications are further allocated within management areas (Eastern, Central, Western Aleutian Islands; Bering Sea; Western, Central, and Eastern Gulf of Alaska) among management programs (open access or CDQ Program), processing components (inshore or offshore), specific gear types (trawl, nontrawl, hook-and-line, pot, jig), and seasons according to regulations 50 CFR 679.20, 50 CFR 679.23, and 50 CFR 679.31 (Tables 2.7-13 through 2.7-16).

Suballocations of TAC to the various gear groups, management areas, and seasons are made according to regulation driven formulas or, for discretionary allocations, according to Secretary of Commerce-approved specifications. NMFS uses in-season management authority to open and close the fisheries (50 CFR 679.25). The entire TAC amount is available to the domestic fishery (50 CFR 679.20). The gear authorized in the federally managed groundfish fisheries off Alaska includes trawl gear, fixed-gear, longline gear, pot gear, and nontrawl gear (50 CFR 679.2 Authorized fishing gear).

Fishing areas correspond to the defined regulatory areas within the fishery management units. The BSAI is divided into 16 reporting areas (Figure 2.7-19), some of which are combined for TAC specification purposes. The Aleutian Islands group comprises regulatory Areas 541, 542, and 543. Referred to individually, 541 represents the eastern Aleutian Islands, 542 the central Aleutian Islands, and 543 the western Aleutian Islands. The GOA is divided into seven reporting areas (Figure 2.7-20): the western Gulf is Area 610, the central Gulf includes Areas 620 and 630, and the eastern Gulf includes Areas 640 and 650. Area 649 is state waters in Prince William Sound: Area 659 is state waters in southeast Alaska.

Table 2.7-12 Common and Scientific Names and Management Categories of Fish Species Likely To Be Taken in the Groundfish Fishery

Common Name	Scientific Name	Category of Species	
		BSAI	GOA
Walleye pollock	*Theragra chalcogramma*	Target–individual Three stocks–Eastern Bering Sea, Aleutian Islands, Bogoslof	Target–individual. Two stocks– western/ central, eastern
Pacific cod	*Gadus macrocephalus*	Target–individual	Target–individual
Alaska plaice	*Pleuronectes quadrituberculatus*	Target–other flatfish complex	Target–shallow water flatfish complex
Atka mackerel	*Pleurogrammus monopterygius*	Target–individual	Target–individual
Arctic flounder	*Liopsetta glacialis*	Target–other flatfish complex	NA
Arrowtooth flounder	*Atheresthes stomias*	Target–arrowtooth flounder complex	Target–individual
Bering flounder	*Hippoglossoides robustus*	Target–flathead sole complex	NA
Butter sole	*Isopsetta isolepis*	Target–other flatfish complex	Target–shallow water flatfish complex
California tonguefish	*Symphurus atricauda*	Target–other flatfish complex	NA
C-O sole	*Pleuronichthys coenosus*	Target–other flatfish complex	Target–shallow water flatfish complex
Curlfin sole	*Pleuronichthys decurrens*	Target–other flatfish complex	Target–shallow water flatfish complex
Deepsea sole	*Embassichthys bathybius*	Target–other flatfish complex	Target–deep water flatfish complex
English sole	*Parophrys vetulus*	Target–other flatfish complex	Target–shallow water flatfish complex
Dover sole	*Microstomus pacificus*	Target–other flatfish complex	Target–deep water flatfish complex
Flathead sole	*Hippoglossoides elassodon*	Target–flathead sole complex	Target–individual
Greenland turbot	*Reinhardtius hippoglossoides*	Target–individual	Target–deep water flatfish complex
Hybrid sole	*Inopsetta ischyra*	Target–other flatfish complex	Target–shallow water flatfish complex
Kamchatka flounder	*Atheresthes evermanni*	Target–arrowtooth flounder complex	NA
Longhead dab	*Limanda proboscidea*	Target–other flatfish complex	Target–shallow water flatfish complex
Pacific sanddab	*Citharichthys sordidus*	Target–other flatfish complex	Target–shallow water flatfish complex
Petrale sole	*Eopsetta jordani*	Target–other flatfish complex	Target–shallow water flatfish complex
Rex sole	*Errex zachirus*	Target–other flatfish complex	Target–individual
Rock sole	*Lepidopsetta bilineata*	Target–individual	Target–shallow water flatfish complex
Roughscale sole	*Clidoderma asperrimum*	Target–other flatfish complex	Target–shallow water flatfish complex
Sand sole	*Psettichthys melanostictus*	Target–other flatfish complex	Target–shallow water flatfish complex
Slender sole	*Lyopsetta exilis*	Target–other flatfish complex	Target–shallow-water flatfish complex
Starry flounder	*Platichthys stellatus*	Target–other flatfish complex	Target–shallow- water flatfish complex
Yellowfin sole	*Limanda aspera*	Target–individual	Target–shallow water flatfish complex

Table 2.7-12 (Cont.) Common and Scientific Names and Management Categories of Fish Species Likely To Be Taken in the Groundfish Fishery

Common Name	Scientific Name	Category of Species	
		BSAI	GOA
Aurora rockfish	*Sebastes aurora*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–slope rockfish complex
Black rockfish	*Sebastes melanops*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–pelagic shelf rockfish complex
Blackgill rockfish	*Sebastes melanostomus*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–slope rockfish complex
Blue rockfish	*Sebastes mystinus*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–pelagic shelf rockfish
Bocaccio	*Sebastes paucispinis*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–slope rockfish complex
Broad-banded thornyhead	*Sebastolobus macrochir*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–thornyhead rockfish complex
Brown rockfish	*Sebastes auriculatus*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	NA
Canary rockfish	*Sebastes pinniger*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–demersal shelf rockfish complex
Chameleon rockfish	*Sebastes phillipsi*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	NA
Chilipepper	*Sebastes goodei*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–slope rockfish complex
China rockfish	*Sebastes nebulosus*	NA	Target–demersal shelf rockfish complex
Copper rockfish	*Sebastes caurinus*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–demersal shelf rockfish complex
Dark-blotched rockfish	*Sebastes crameri*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–slope rockfish complex
Dusky rockfish	*Sebastes ciliatus*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–pelagic shelf rockfish complex
Gray rockfish	*Sebastes glaucous*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	NA
Green-striped rockfish	*Sebastes elongastus*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–slope rockfish complex
Harlequin rockfish	*Sebastes variegatus*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–slope rockfish complex
Longspine thornyhead	*Sebastolobus altivelis*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–thornyhead rockfish complex

Table 2.7-12 (Cont.) Common and Scientific Names and Management Categories of Fish Species Likely To Be Taken in the Groundfish Fishery

Common Name	Scientific Name	Category of Species	
		BSAI	GOA
Northern rockfish	*Sebastes polyspinis*	Target–other red rockfish Complex in eastern Bering Sea and northern/sharpchin complex in Aleutian Islands	Target–individual
Pacific ocean perch	*Sebastes alutus*	Target–individual Two stocks–eastern Bering Sea, Aleutian Islands	Target–individual three stocks–western, central, eastern
Pink rose rockfish	*Sebastes simulator*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	NA
Pygmy rockfish	*Sebastes wilsoni*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–slope rockfish complex
Quillback rockfish	*Sebastes maliger*	NA	Target–demersal shelf rockfish complex
Redbanded rockfish	*Sebastes babcocki*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–slope rockfish complex
Redstripe rockfish	*Sebastes proriger*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–slope rockfish complex
Rosethorn rockfish	*Sebastes helvomaculatus*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–demersal shelf rockfish
Rosy rockfish	*Sebastes rosaceus*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	NA
Rougheye rockfish	*Sebastes aleutianus*	Target–other red rockfish in the eastern Bering Sea and shortraker/rougheye complex in the Aleutian Islands	Target–shortraker/ rougheye complex
Sablefish (black cod)	*Anoplopoma fimbria*	Target–individual. Two stocks–eastern Bering Sea, Aleutian Islands	Target–individual
Sharpchin rockfish	*Sebastes zacentrus*	Target–other red rockfish complex in the eastern Bering Sea and northern/sharpchin complex in the Aleutian Islands	Target–slope rockfish complex
Shortbelly rockfish	*Sebastes jordani*	NA	Target–slope rockfish complex
Shortraker rockfish	*Sebastes borealis*	Target–other red rockfish in the eastern Bering Sea and shortraker/rougheye complex in the Aleutian Islands	Target–shortraker/ rougheye complex
Shortspine thornyhead	*Sebastolobus alascanus*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–thornyhead rockfish complex
Silvergrey rockfish	*Sebastes brevispinis*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–slope rockfish complex
Splitnose rockfish	*Sebastes diploproa*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–slope rockfish complex

Table 2.7-12 (Cont.) Common and Scientific Names and Management Categories of Fish Species Likely To Be Taken in the Groundfish Fishery

Common Name	Scientific Name	Category of Species	
		BSAI	GOA
Stripetail rockfish	*Sebastes saxicola*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–slope rockfish complex
Tiger rockfish	*Sebastes nigrocinctus*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–demersal shelf rockfish
Vermilion rockfish	*Sebastes miniatus*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–slope rockfish complex
Widow rockfish	*Sebastes entomelas*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–pelagic shelf rockfish complex
Yelloweye rockfish	*Sebastes ruberrimus*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–demersal shelf rockfish complex
Yellowmouth rockfish	*Sebastes reedi*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–slope rockfish complex
Yellowtail rockfish	*Sebastes flavidus*	Target–other rockfish complex Two stocks–eastern Bering Sea, Aleutian Islands	Target–pelagic shelf rockfish complex
Squid	*Berryteuthis magister*	Target–squid complex	Other species
Squid	*Onychoteuthis borealijaponicus*	Target–squid complex	Other species
Antlered sculpin	*Enophrys dicerus*	Other species	NA
Armorhead sculpin	*Gymnocanthus galeatus*	Other species	Other species
Bigmouth sculpin	*Hemitripterus bolini*	Other species	Other species
Blackfin sculpin	*Malacocottus kincaidi*	Other species	Other species
Blob sculpin	*Psychrolutes phrictus*	Other species	NA
Brown Irish lord	*Hemilepidotus spinosus*	Other species	NA
Butterfly sculpin	*Hemilepidotus papilio*	Other species	NA
Calico sculpin	*Clinocottus embryum*	Other species	NA
Crested sculpin	*Blepsias bilobus*	Other species	NA
Dusky sculpin	*Icelinus burchami*	Other species	Other species
Great sculpin	*Myoxocephalus polyacanthocephalus*	Other species	Other species
Pacific staghorn sculpin	*Leptocottus armatus*	Other species	NA
Plain sculpin	*Myoxocephalus jaok*	Other species	NA
Red Irish lord	*Hemilepidotus hemilepidotus*	Other species	Other species
Ribbed sculpin	*Triglops pingeli*	Other species	Other species
Roughspine sculpin	*Triglops macellus*	NA	Other species
Scissortail sculpin	*Triglops forficata*	Other species	NA
Shorthorn sculpin	*Myoxocephalus scorpius*	Other species	NA
Spinyhead sculpin	*Dasycottus setiger*	Other species	Other species
Tadpole sculpin	*Psychrolutes paradoxus*	Other species	Other species
Thorny sculpin	*Icelus spiniger*	Other species	Other species
Warty sculpin	*Myoxocephalus groenlandicus*	Other species	NA
Yellow Irish lord	*Hemilepidotus jordani*	Other species	Other species
Blue shark	*Prionace glauca*	Other species	Other species
Brown cat shark	*Apristurus brunneus*	NA	Other species
Pacific sleeper shark	*Somniosus pacificus*	Other species	Other species

Table 2.7-12 (Cont.) Common and Scientific Names and Management Categories of Fish Species Likely To Be Taken in the Groundfish Fishery

Common Name	Scientific Name	Category of Species	
		BSAI	GOA
Salmon shark	*Lamna ditropis*	Other species	Other species
Sixgill shark	*Hexanchus griseus*	Other species	Other species
Soupfin shark	*Galeorhinus galeus*	Other species	NA
Spiny dogfish shark	*Squalus acanthias*	Other species	Other species
Alaska skate	*Bathyraja parmifera*	Other species	Other species
Aleutian skate	*Bathyraja aleutica*	Other species	Other species
Big skate	*Raja binoculata*	Other species	Other species
Commander skate	*Bathyraja lindbergi*	Other species	NA
Deepsea skate	*Bathyraja abyssicola*	Other species	NA
Flathead skate	*Bathyraja rosispinis*	NA	Other species
Golden skate	*Bathyraja smirnovi*	Other species	NA
Longnose skate	*Raja rhina*	Other species	Other species
Mud skate	*Bathyraja taranetzi*	Other species	NA
Okhotsk skate	*Bathyraja violacea*	Other species	NA
Roughtail skate	*Bathyraja trachura*	Other species	Other species
Sandpaper skate	*Bathyraja interrupta*	Other species	Other species
Starry skate	*Raja stellulata*	Other species	Other species
White-blotched skate	*Bathyraja maculata*	Other species	NA
Whitebrow skate	*Bathyraja minispinosa*	Other species	NA
Octopus	*Octopus dofleini*	Other species	Other species
Octopus	*Opisthoteuthis california*	Other species	Other species
Capelin	*Mallotus villosus*	Forage fish	Forage fish
Eulachon	*Thaleichthys pacificus*	Forage fish	Forage fish
Rainbow smelt	*Osmerus mordax*	Forage fish	Forage fish
Pacific sand fish	Family Trichodontidae	Forage fish	Forage fish
Gunnels	Family Pholidae	Forage fish	Forage fish
Pricklebacks, warbonnets, eelblennys, cockscombs, shannys	Family Stichaeidae	Forage fish	Forage fish
Bristlemouths, lightfishes, anglemouths	Family Gonostomatidae	Forage fish	Forage fish
Krill	Order Euphausiacea	Forage fish	Target—forage fish
Alaska king crab	*Paralithodes* spp	Prohibited species	Prohibited species
Alaska king crab	*Lithodes* spp.	Prohibited species	Prohibited species
Tanner crab	*Chionoecetes* spp	Prohibited species	Prohibited species
Pacific herring	*Clupea harengus pallasi*	Prohibited species	Prohibited species
Pacific halibut	*Hippoglossus stenolepis*	Prohibited species	Prohibited species
Steelhead trout	*Oncorhynchus mykiss*	Prohibited species	Prohibited species
Chum salmon	*Oncorhynchus keta*	Prohibited species	Prohibited species
Pink salmon	*Oncorhynchus gorbuscha*	Prohibited species	Prohibited species
Coho salmon	*Oncorhynchus kisutch*	Prohibited species	Prohibited species
Chinook salmon	*Oncorhynchus tshawytscha*	Prohibited species	Prohibited species
Sockeye salmon	*Oncorhynchus nerka*	Prohibited species	Prohibited species

Note: Separate columns under management unit (BSAI and GOA) are because some of the species are in different management categories in the BSAI management area than in the GOA management area.
NA – The species either is not known to range within the management area or it is not included in the fishery management plan for that area as one of the managed species.

Source: The target and other species list was compiled from the SAFE reports (NMFS 1999).

Table 2.7-13 Interim Total Allowable Catch; Final Acceptable Biological Catch, Total Allowable Catch, and Overfishing Level Amounts; and Actual Harvest for the Bering Sea and Aleutian Islands Management Area, 1999, in Metric Tons

Species or Management Group	Area	1999 Specifications				1999 Actual Harvest
		Interim TAC specifications	ABC	TAC	OFL	
Pollock	BS	440,599	92,000	992,000	1,720,000	988,674
	Aleutian Islands	22,514	23,800	2,000	31,700	981
	Bogoslof District	946	15,300	1,000	21,000	29
Pacific cod	BSAI	48,563	177,000	177,000	264,000	174,856
Sablefish	BS	150	1,340	1,340	2,090	659
	Aleutian Islands	79	1,860	1,380	2,890	568
Atka mackerel	Total	14,869	73,300	66,400	148,000	56,231
	Western Aleutian Islands	6,244	30,700	27,000		
	Central Aleutian Islands	5,180	25,600	22,400		
	Eastern Aleutian Islands/Bering Sea	3,445	17,000	17,000		
Yellowfin sole	BSAI	50,875	212,000	207,980	308,000	69,288
Rock sole	BSAI	23,125	309,000	120,000	444,000	41,085
Greenland turbot	Total	3,469	14,200	9,000	29,700	5,851
	BS		9,515	6,030		
	Aleutian Islands		4,685	2,970		
Arrowtooth flounder	BSAI	3,655	140,000	134,354	219,000	11,353
Flathead sole	BSAI	23,125	77,300	77,300	118,000	18,566
Other flatfish	BSAI	20,682	154,000	54,000	248,000	15,686
Pacific ocean perch	BS	324	1,900	1,400	3,600	416
	Aleutian Islands Total	2,798	13,500	13,500	19,100	12,486
	Western Aleutian Islands	1,291	6,220	6,220		
	Central Aleutian Islands	798	3,850	3,850		
	Eastern Aleutian Islands	709	3,430	3,430		
Other red rockfish	BS	62	267	267	356	237
Sharpchin/Northern	Aleutian Islands	978	4,230	4,230	5,640	5,502
Shortraker/rougheye	Aleutian Islands	223	965	965	1,290	513
Other rockfish	BS	85	369	369	492	141
	Aleutian Islands	159	685	685	913	658
Squid	BSAI	450	1,970	1,970	2,620	401
Other species	BSAI	5,894	32,860	32,860	129,000	20,584
TOTAL		681,291	2,247,846	2,000,000	3,719,391	1,424,765

Notes: ABC – acceptable biological catch; BS – Bering Sea; OFL – overfishing level; TAC – total allowable catch

Table 2.7-14 Interim Total Allowable Catch and Final Acceptable Biological Catch, Total Allowable Catch, and Overfishing Level Amounts for the Gulf of Alaska Management Area, 1999, in Metric Tons

Species or Management Group	1999 Specifications					1999 Actual Harvest
	Area	Interim TAC	ABC	TAC	OFL	
Pollock	Shumagin (610)	7,450	23,120	23,120		23,384
	Chirikof (620)	12,510	38,840	38,520		38,142
	Kodiak (630)	9,830	30,520	30,520		30,133
	Subtotal				134,100	
	WYK			2,110		1,759
	SEO			6,330		4
	East (WYK SEO)	1,395	8,440		12,300	
Pacific cod	Western GOA	4,607	29,540	23,630		23,158
	Central GOA	8,344	53,170	42,935		44,547
	Eastern GOA	234	1,690	1,270		901
	Total				134,000	
Flatfish, deep	Western GOA	85	240	240		22
	Central GOA	923	2,740	2,740		1,865
	WYK		1,720	1,720		389
	SEO		1,350	1,350		9
	East (WYK SEO)	785				
	Total				8,070	
Rex sole	Western GOA	298	1,190	1,190		604
	Central GOA	1,373	5,490	5,490		2,393
	WYK		850	850		41
	SEO		1,620	1,620		22
	East (WYK SEO)	618				
	Total				11,920	
Flatfish, shallow water	Western GOA	1,125	22,570	4,500		268
	Central GOA	3,238	19,260	12,950		2,298
	WYK		250	250		6
	SEO		1,070	1,070		5
	East (WYK SEO)	295				
	Total				5,9540	
Flathead sole	Western GOA	500	8,440	2,000		186
	Central GOA	1,250	15,630	5,000		687
	WYK		1,270	1,270		16
	SEO		770	770		11
	East (WYK SEO)	510				
	Total				34,010	
Arrowtooth	Western GOA	1,250	34,400	5,000		3,681
	Central GOA	6,250	155,930	25,000		11,900
	WYK		13,260	2,500		382
	SEO		13,520	2,500		244
	East (WYK SEO)	1,250				
	Total				308,880	

Table 2.7-14 (Cont.) Interim Total Allowable Catch and Final Acceptable Biological Catch, Total Allowable Catch, and Overfishing Level Amounts for the Gulf of Alaska Management Area, 1999, in Metric Tons

Species or Management Group		1999 Specifications				1999 Actual Harvest
	Area	Interim TAC	ABC	TAC	OFL	
Sablefish	Western GOA	460	1,820	1,820		1,487
	Central GOA	1,580	5,590	5,590		5,873
	WYK			2,090		1,709
	SEO			3,200		3,158
	East (WYK SEO)	1,490	5,290	5,290		
	Total				19,720	
Rockfish, other slope	Western GOA	5	20	20		39
	Central GOA	162	650	650		614
	WYK		470	470		122
	SEO		4,130	4,130		13
	East (WYK SEO)	375				
	Total				7,560	
Rockfish, northern	Western GOA	210	840	840		574
	Central GOA	1,037	4,150	4,150		4,825
	Eastern GOA	3	na	na		0
	Total				9,420	
Pacific ocean perch	Western GOA	453	1,850	1,850	2,610	1,935
	Central GOA	1,650	6,760	6,760	9,520	7,910
	WYK		820	820		627
	SEO		3,690	3,160		0
	East (WYK SEO)	592			6,360	
	Total				18,490	
Shortraker/	Western GOA	40	160	160		194
	Central GOA	242	970	970		580
	Eastern GOA	115	460	460		537
	Total				2,740	
Rockfish, pelagic shelf	Western GOA	155	530	530		130
	Central GOA	815	3,370	3,370		3,835
	WYK		740	740		672
	SEO		240	240		22
	East (WYK SEO)	250				
	Total				8,190	297
Rockfish, demersal	SEO	140	560	560	950	
Atka mackerel	Gulfwide	150	600	600	6,200	262
Thornyhead	Western GOA	63	260	260		283
	Central GOA	178	700	700		583
	Eastern GOA	260	1,030	1,030		417
	Total				2,800	
Other species	Gulfwide	3,893	na	14,600	na	3,859
TOTAL		**78,438**	**532,590**	**306,535**	**778,890**	**227,614**

Notes: ABC – acceptable biological catch
GOA – Gulf of Alaska
OFL – overfishing level
na – not applicable
SEO – Southeast Outside District
TAC – total allowable catch
WYK – West Yakutat

Table 2.7-15 Interim Total Allowable Catch; Final Acceptable Biological Catch, Total Allowable Catch, and Overfishing Level Amounts; and Actual Harvest for the Bering Sea and Aleutian Islands Management Area, 2000, in Metric Tons

Species or Management Group	Area	2000 Specifications				2000 Actual Harvest[a]
		Interim TAC Specification	ABC	TAC	OFL	
Pollock	BS	389,758	1,139,000	1,139,000	1,680,000	
	Aleutian Islands	1,800	23,800	2,000	31,700	
	Bogoslof District	900	23,300	1,000	30,400	
Pacific cod	BSAI	41,013	193,000	193,000	240,000	
Sablefish	BS	156	1,470	1,470	1,750	
	Aleutian Islands	129	2,430	2,430	3,090	
Atka mackerel	Total	15,045	70,800	70,800	119,000	
	Western Aleutian Islands	6,311	29,700	29,700	na	
	Central Aleutian Islands	5,249	24,700	24,700	na	
	Eastern Aleutian Islands/BS	3,450	16,400	16,400	na	
Yellowfin sole	BSAI	26,193	191,000	123,262	226,000	
Rock sole	BSAI	28,637	230,000	134,760	273,000	
Greenland turbot	Total	1,977	9,300	9,300	42,000	
	BS	1,324	6,231	6,231	na	
	Aleutian Islands	652	3,069	3,069	na	
Arrowtooth flounder	BSAI	27,838	131,000	131,000	160,000	
Flathead sole	BSAI	11,189	73,500	52,652	90,000	
Other flatfish	BSAI	17,811	117,000	83,813	141,000	
Pacific ocean perch	BS	553	2,600	2,600	3,100	
	Aleutian Islands Total	2,614	12,300	12,300	14,400	
	Western Aleutian Islands	1,205	5,670	5,670	na	
	Central Aleutian Islands	746	3,510	3,510	na	
	Eastern Aleutian Islands	663	3,120	3,120	na	
Other red rockfish	BS	41	194	194	259	
Sharpchin/Northern	Aleutian Islands	1,095	5,150	5,150	6,870	
Shortraker/rougheye	Aleutian Islands	188	885	885	1,180	
Other rockfish	BS	79	369	369	492	
	Aleutian Islands	146	685	685	913	
Squid	BSAI	419	1,970	1,970	2,620	
Other species	BSAI	6,664	31,360	31,360	71,500	
TOTAL		593,845	2,260,113	2,000,000	3,139,274	

Notes: [a]Not available
ABC – acceptable biological catch
BS – Bering Sea
na – data not applicable
OFL – overfishing level
TAC – total allowable catch

Table 2.7-16 Interim Total Allowable Catch and Final Acceptable Biological Catch, Total Allowable Catch, and Overfishing Level Amounts for the Gulf of Alaska Management Area, 2000, in Metric Tons

Species or Management Group	Area	2000 Specifications			
		Interim TAC Specifications	ABC	TAC	OFL
Pollock	Shumagin (610)		38,350	38,350	na
	Chirikof (620)		22,820	22,820	na
	Kodiak (630)		30,030	30,030	na
	Subtotal	23,120	2,340	2,340	na
	WYK (640)	528	93,540	93,540	130,760
	SEO (650)	1,582	6,460	6,460	8,610
	Total	25,230	100,000	100,000	100,000
Pacific cod	Western GOA	4,726	27,500	20,625	
	Central GOA	8,687	43,550	35,165	
	Eastern GOA	254	5,350	4,010	
	Total	13,567	76,400	59,800	102,000
Flatfish, deep water	Western GOA	60	280	280	
	Central GOA	685	2,710	2,710	
	WYK	430	1,240	1,240	
	SEO	337	1,070	1,070	
	Total	1,512	5,300	5,300	6,980
Rex sole	Western GOA	298	1,230	1,230	
	Central GOA	1,373	5,660	5,660	
	WYK	212	1,540	1,540	
	SEO	405	1,010	1,010	
	Total	2,288	9,440	9,440	12,300
Flatfish, shallow water	Western GOA	1,125	19,510	4,500	
	Central GOA	3,237	16,400	12,950	
	WYK	62	790	790	
	SEO	268	1,160	1,160	
	Total	4,692	37,860	19,400	45,330
Arrowtooth	Western GOA	1,250	16,160	5,000	
	Central GOA	6,250	97,710	25,000	
	WYK	625	23,770	2,500	
	SEO	625	7,720	2,500	
	Total	8,750	145,360	35,000	173,910
Sablefish	Western GOA	455	1,840	1,840	
	Central GOA	1,398	5,730	5,730	
	WYK	456	2,207	2,207	
	SEO	800	3,553	3,553	
	East (WYK SEO)	1,256	5,760	5,760	
	Total	3,175	13,330	13,330	16,660

Table 2.7-16 (Cont.) Interim Total Allowable Catch and Final Acceptable Biological Catch, Total Allowable Catch, and Overfishing Level Amounts for the Gulf of Alaska Management Area, 2000, in Metric Tons

Species or Management Group	Area	2000 Specifications Interim TAC Specifications	ABC	TAC	OFL
Rockfish, other slope	Western GOA	5	20	20	
	Central GOA	162	740	740	
	WYK	117	250	250	
	SEO	1,033	3,890	3,890	
	Total	1,317	4,900	4,900	6,390
Rockfish, northern	Western GOA	210	630	630	
	Central GOA	1,037	4,490	4,490	
	Eastern GOA	na	na	na	
	Total	1,247	5,120	5,120	7,510
Pacific ocean perch	Western GOA	462	1,240	1,240	1,460
	Central GOA	1,690	9,240	9,240	10,930
	WYK	205	840	840	
	SEO	790	1,700	1,700	
	East (WYK SEO)				3,000
	Total	3,147	13,020	13,020	15,390
Shortraker/rougheye	Western GOA	40	210	210	
	Central GOA	242	930	930	
	Eastern GOA	115	590	590	
	Total	397	1,730	1,730	2,510
Rockfish, pelagic shelf	Western GOA	132	550	550	
	Central GOA	843	4,080	4,080	
	WYK	185	580	580	
	SEO	60	770	770	
	Total	1,220	5,980	5,980	9,040
Rockfish, demersal	SEO	140	340	340	420
Atka mackerel	Gulfwide	150	600	600	600
Thornyhead	Western GOA	65	430	430	
	Central GOA	175	990	990	
	Eastern GOA	257	940	940	
	Total	497	2,360	2,360	2,820
Other species	Gulfwide	3,650	na	14,270	
TOTAL		73,239	448,010	299,650	581,040

Notes: ABC – acceptable biological catch
GOA – Gulf of Alaska
OFL – overfishing level
SEO – Southeast Outside District
TAC – total allowable catch
WYK – West Yukon

The fishing year coincides with the calendar year, January 1 to December 31 (50 CFR 679.2 and 679.23). Depending on the target species' spatial allocation (detailed below in the fisheries descriptions), additional specifications are made to particular seasons (quarters of the year or combinations of quarters) within the year. Fisheries are opened and closed by regulatory announcement. Closures are made when in-season information indicates the apportioned TAC or available PSC has been or will soon be reached, or at the end of the specified season if the particular TAC has not been taken (50 CFR 679.25).

Drafting, review, clearance, and publication in the *Federal Register* of final ABCs, TACs, and PSC limits Catch accounting in the U.S. groundfish fisheries is divided into species that must be discarded (50 CFR 679.20(d)(2) and 679.21(b)) and those that may be or are required to be retained (50 CFR 679.20(e) and (f) and 679.27). Of the total TAC, the CDQ Program in the BSAI is allocated 10 percent of the allowable catch for pollock; 7.5 percent of all other groundfish, except 20 percent of fixed gear allocation for sablefish; and 7.5 percent for prohibited species (50 CFR 679.31). The rest of the TAC is then apportioned to directed fishery or bycatch reserve according to spatial and temporal management measures that apply. Unless specified otherwise, in both FMP areas, trawl gear may only fish from January 20 though December 31 (50 CFR 679.23(c)). The remaining gear types may start fishing January 1 (50 CFR 679.23 (a)).

2.7.5.1 Annual Promulgation of TAC

Rules to establish harvest specifications are required for harvest in these federal groundfish fisheries to resume from one fishing year to the next. Specifying TAC and PSC limits follows the fishery regulation rulemaking process (Section 2.7.8). To conform with rulemaking requirements, particularly those originating from the Administrative Procedures Act (APA) concerning standards for prior public review and input, three separate rules are published per management area, per year. The publications are, sequentially: (1) proposed specifications, (2) interim specifications, and (3) final specifications. This three-part process has been in place, with various refinements, since implementation of the FMPs. The process is explained in more detail below and summarized in Table 2.7-17.

Proposed Specifications

Proposed ABC, TAC, and PSC[1] specifications are recommended by the Council at its October meeting and published in the *Federal Register* for public review and comment. The recommendations are based on the preliminary SAFE reports prepared by the Council's GOA and BSAI Plan Teams during and subsequent to their September meetings. Any new data on stock levels obtained from the previous summer's surveys are

[1]BSAI crab and herring and GOA halibut only; BSAI PSC limits for halibut and salmon are established in regulations (50 CFR 679.21.)

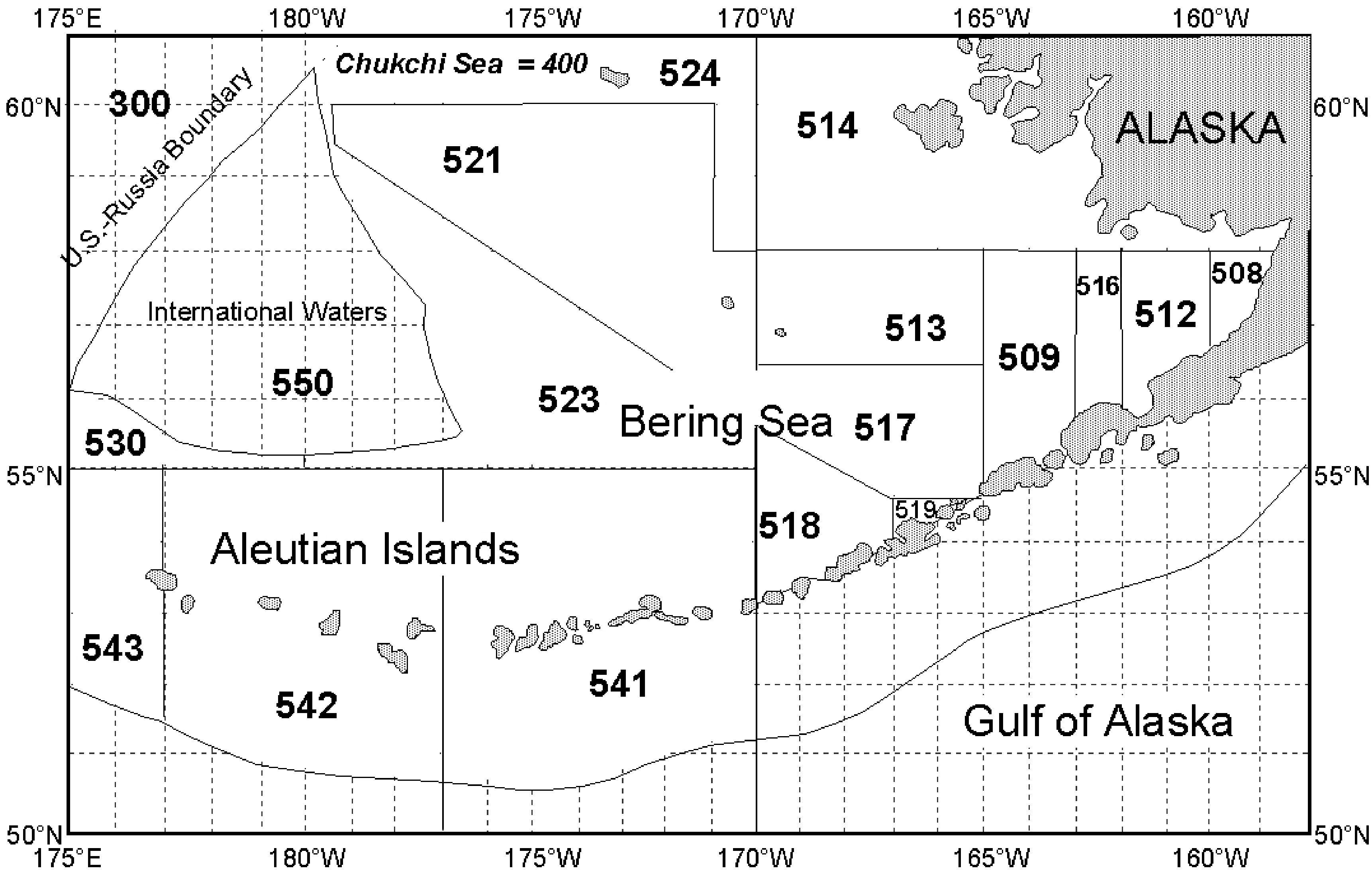


Figure 2.7-19 Bering Sea and Aleutian Islands statistical and reporting areas. Source: NMFS.

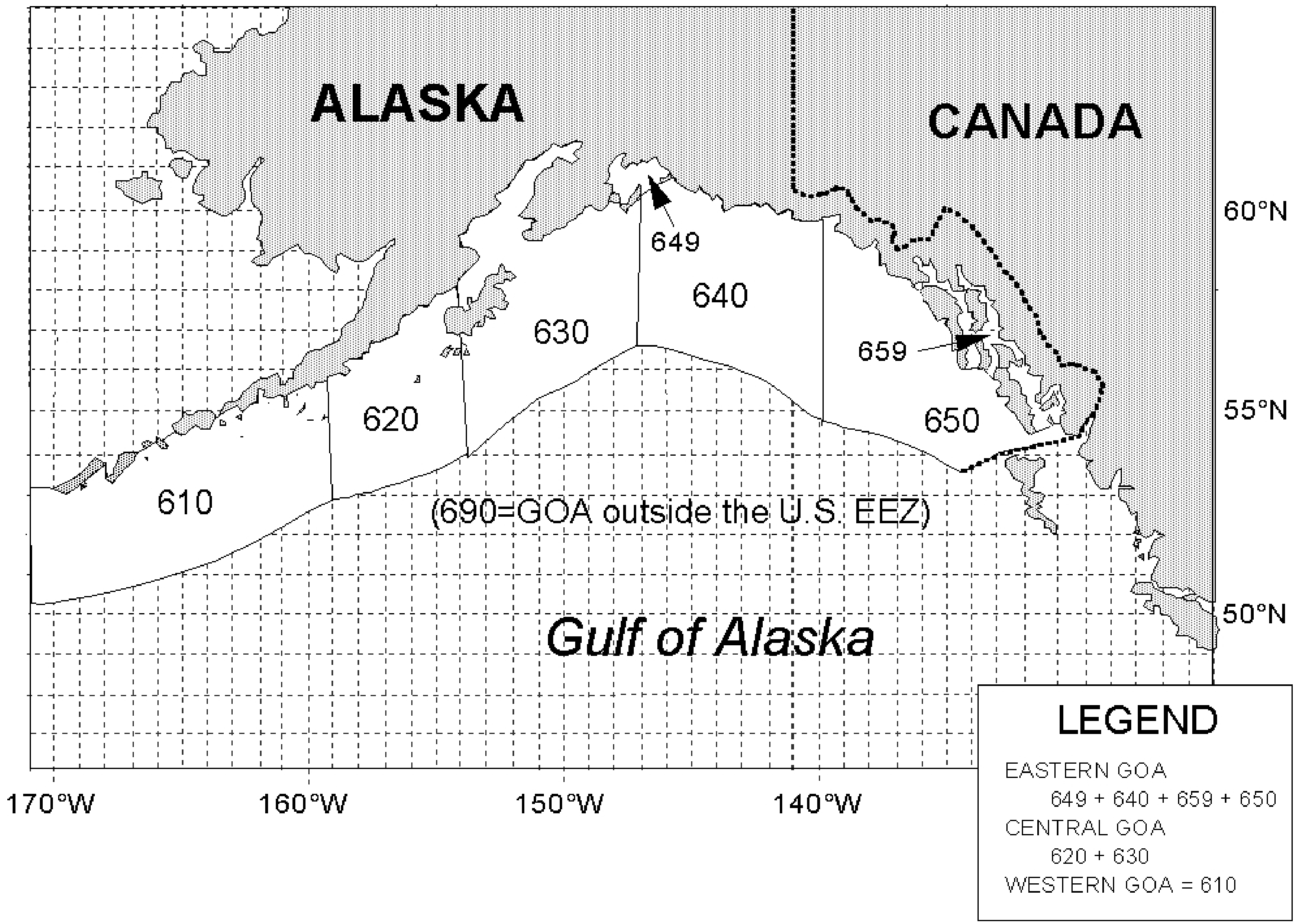


Figure 2.7-20 Gulf of Alaska statistical and reporting areas. Source: NMFS.

Table 2.7-17 Steps and Time Line for Annual Total Allowable Catch Specifications and Prohibited Species Catch Limit Rules

Month	Step in the Process
September	Stock Assessment Authors provide Groundfish Plan Teams proposed ABC recommendations. Groundfish Plan Teams provide SSC, AP, and Council proposed ABC recommendations.
October	Council recommends proposed ABC, TAC specifications, and PSC limits.
November	Specifications are published as proposed rule.
December	Interim specifications are published as a final rule. Groundfish Plan Teams provide final ABC recommendations. Council recommends final ABC, TAC specifications, and PSC limits.
January	Nontrawl groundfish fisheries open January 1, and trawl fisheries open January 20 under interim specifications.
February-March	Final specification are published as final rule and replace interim specifications.

Notes: ABC – acceptable biological catch
AP – Advisory Panel
PSC – prohibited species catch
SSC – Scientific and Statistical Committee
TAC – total allowable catch

generally not yet in a useable form; therefore, the proposed specifications are based on previous year's data. Preliminary SAFE reports are incorporated into the environmental analysis accompanying the proposed specifications rule. The Plan Teams' meetings and Council meeting are open public meetings. The Council also solicits public comment on the proposed TAC specifications during its October meeting.

Drafting, review, clearance, and publication in the *Federal Register* of proposed ABCs, TACs, and PSC limits takes approximately two months. In 1999, for example, the Council met and recommended proposed year 2000 specifications on October 17, 1999, and the proposed specifications were published December 13, 1999, (BSAI 64 FR 69464 and GOA 64 FR 69457). December 13, 1999, therefore, was the first day of the 30-day public comment period required under the APA for a proposed rule.

Interim Specifications

Interim TAC specifications are mathematical determinations using the proposed specifications according to implementing regulations 50 CFR 679.20(c)(2), authorizing one-fourth of each proposed Interim Total Allowable Catch (ITAC) and apportionment thereof, one-fourth of each PSC allowance and the first seasonal allowance of GOA and BSAI pollock and BSAI Atka mackerel to be in effect on January 1 on an interim basis and to remain in effect until superceded by final specifications. NMFS published the interim specifications in the *Federal Register* as soon as practicable after the October Council meeting. In 1999, for example, the year 2000 interim TAC specifications were published January 3, 2000 (BSAI 65 FR 60 and GOA 65 FR 65). Retention of sablefish with fixed gear is not currently authorized under interim specifications. Further, existing regulations do not provide for an interim specification for the CDQ nontrawl sablefish reserve or for an interim specification for sablefish managed under the IFQ program.

Final Specifications

Final TAC and PSC specifications are recommended by the Council at its December meeting. The recommendations are based on SAFE reports prepared by the Council's GOA and BSAI Groundfish Plan Teams during and subsequent to their November meetings. Final SAFE reports are incorporated into the environmental analysis accompanying the final rule (NMFS 1999b). The Groundfish Plan Team meetings and Council meetings are open public meetings. The Council solicits public comment on the proposed TAC specifications during its December meeting. takes approximately two months. For the year 2000 final specifications, the Council met December 7–12, 1999, and recommended final TAC specifications and PSC limits that were published in the *Federal Register* on February 18, 2000.

While the above is an accurate description of the TAC-setting process to date, it is known to have flaws. The proposed specifications are outdated by the time they are published and the public has a formal opportunity to comment on them.

2.7.5.2 Stock Assessment Information

The flow of new target species stock assessment information through the process starts when the AFSC stock assessment authors make an ABC and OFL recommendation for their stocks. These recommendations are documented in the preliminary or final SAFE reports, depending on when they are first available. For most species and species groups, the timing of any new survey information that would lead to new calculations of ABC, and the OFL is subsequent to deadlines for the preliminary SAFE and does not become known until mid- to late-October. The information is first available to the Plan Teams at their November meetings and is included in the final SAFE. For species and species groups that are not receiving new stock survey information in a given year, the stock assessment author's prior year ABC and OFL recommendation is repeated in the preliminary and final SAFE reports.

New data from resource assessment surveys become available under different schedules for different areas and species. Beginning with the 1999 GOA survey, AFSC initiated a new survey strategy to increase the frequency of the triennial survey schedule to biennial (Table 2.7-11 Section 2.7.3.2).

2.7.5.3 Role of Plan Teams, Scientific and Statistical Committee, Advisory Panel, and North Pacific Fishery Management Council, and the Secretary of Commerce in Total Allowable Catch Specifications

The role of the Council-appointed Groundfish Plan Teams is to make ABC and OFL recommendations, which may be, but do not have to be, different from the stock assessment author's recommendation. These recommendations are also documented in the SAFE reports.

The role of the Council's Scientific and Statistical Committee is to make proposed ABC and OFL recommendations at the October Council meeting and final recommendations at the December Council meeting. These recommendations are documented in the Council meeting minutes.

The role of the Council's Advisory Panel is to recommend TAC specifications and PSC limits to the Council. Implicit in the Advisory Panel's TAC recommendations are acknowledgment of the Plan Team's and SSC's ABC recommendations, to the extent a TAC recommended by the panel will not be higher than an ABC recommendation.

The Council makes the last run at determining ABC and recommending proposed and final TAC specifications and PSC limits. The proposed specifications are made at the October meeting and the final specifications at the December meeting. Council action taken during open public meetings, is informed through the SAFE reports, which are part of an environmental analysis prepared according to National Environmental Policy Act (NEPA) regulations.

Since 1991, an environmental assessment (EA) has been prepared on each year's TAC specifications (new EA each year). These EAs are used in the decisionmaking process and accompany the specification rules through regulatory review and filing with the Office of the *Federal Register*.

NMFS packages the Council recommendations into proposed or final rule specification documents and forwards them to the Secretary of Commerce for approval. Secretarial approval of final specifications usually occurs by March for the subject fishing year.

Because some fisheries would be under way before final specifications approval, an interim specifications rule is published on or before January 1 by the Secretary of Commerce. The interim specifications implement one-fourth of the proposed TAC specifications and apportionments thereof toward fisheries occurring in the first quarter of the calendar year (50 CFR 679.20(c)(2)). Upon approval, the new TAC specifications replace the preliminary TAC specifications (50 CFR 679.20(c)(3)).

2.7.6 Derivation of Minimum Stock Size Threshold

The National Standards Guidelines require that each FMP specify, to the maximum extent possible, objective and measurable status determination criteria for each stock or stock complex covered by that FMP, provide an analysis of how the status determination criteria were chosen, and describe how they relate to reproductive potential. One such criterion is the maximum fishing mortality threshold, equivalent to OFL in the BSAI and GOA groundfish FMPs (Section 2.7.4). Exceeding the maximum fishing mortality threshold for a period of one year or more constitutes *overfishing*. The second status determination criterion is the minimum stock size threshold (MSST), which has no explicit equivalent in the BSAI and GOA Groundfish FMPs. If a stock falls below its minimum stock size threshold, the stock is considered *overfished*.

Although MSSTs are not specified by the BSAI and GOA Groundfish FMPs, the fact that their use is required by the National Standard Guidelines resulted in their becoming a standard component of the SAFE Reports prepared in 1999 for the 2000 fishery[1]. To evaluate stocks with respect to their minimum stock size thresholds, the 1999 SAFE Reports contained two sets of projections for each stock managed under Tiers 1, 2, or 3 of Amendments 56/56. The two sets of projections were distinguished by the harvest scenario assumed (see below). For each harvest scenario, the projections began with the vector of 1999 numbers at age estimated in the respective assessment. This vector was then projected forward to the beginning of 2000 using the schedules of natural mortality and selectivity described in the assessment and the best available estimate of total (year-end) catch for 1999. In each subsequent year, the projected fishing mortality rate was prescribed on the basis of the spawning biomass in that year and the respective harvest scenario. In each year, projected recruitment was drawn from a distribution whose parameters consisted of maximum likelihood estimates determined from the time series of recruitments estimated in the assessment. Because an environmental regime shift appears to have occurred around 1977, only year classes spawned after 1976 were included in this time series. Projected spawning biomass was computed in each year based on the time of peak spawning and the maturity

[1]The proxy for MSSTs as described in the Federal Register notice announcing the approval of Amendments 56/56 proved unworkable and NMFS relied on the procedure described in this section for specifying MSSTs for the 2000 fishing year.

and weight schedules described in the assessment. Total catch was assumed to equal the catch associated with the respective harvest scenario in all years. This projection scheme was run 1,000 times to obtain distributions of possible future stock sizes, fishing mortality rates, and catches.

The harvest scenarios used in the two sets of projections were as follows (maximum F_{ABC} refers to the maximum permissible value of F_{ABC} under Amendment 56):

- *Scenario 1*: In all future years, F is set equal to F_{OFL}.
- *Scenario 2*: In 2000 and 2001, F is set equal to *max* F_{ABC}, and in all subsequent years, F is set equal to F_{OFL}.

Harvest scenarios 1 and 2 were used to determine the status of each stock with respect to its MSST as follows (for Tier 3 stocks, the MSY level is defined as $B_{35\%}$):

- *Is the stock overfished?* This depends on the stock's estimated spawning biomass in 2000:
  - If spawning biomass for 2000 is estimated to be below ½ B_{MSY}, the stock is below its MSST.
  - If spawning biomass for 2000 is estimated to be above B_{MSY}, the stock is above its MSST.
  - If spawning biomass for 2000 is estimated to be above ½ B_{MSY} but below B_{MSY}, the stock's status relative to MSST is determined by referring to harvest scenario #1. If the mean spawning biomass for 2010 is below B_{MSY}, the stock is below its MSST. Otherwise, the stock is above its MSST.
- *Is the stock approaching an overfished condition?* This is determined by referring to harvest scenario #2:
  - If the mean spawning biomass for 2002 is below ½ B_{MSY}, the stock is approaching an overfished condition.
  - If the mean spawning biomass for 2002 is above B_{MSY}, the stock is not approaching an overfished condition.
  - If the mean spawning biomass for 2002 is above ½ B_{MSY} but below B_{MSY}, the determination depends on the mean spawning biomass for 2012. If the mean spawning biomass for 2012 is below B_{MSY}, the stock is approaching an overfished condition. Otherwise, the stock is not approaching an overfished condition.

It is currently considered impossible to evaluate the status of stocks in Tiers 4–6 with respect to their MSSTs because stocks qualify for management under these tiers only if reference stock levels (such as MSST) cannot be reliably estimated.